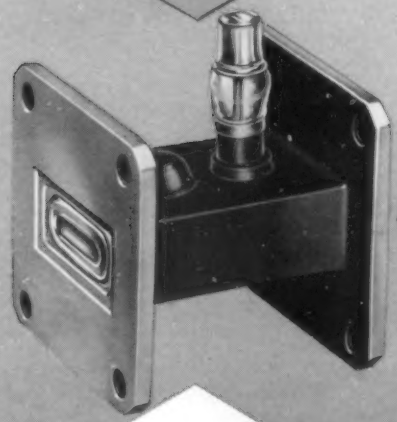
CANADIAN ELECTRONICS ENGINEERING

MARCH 1959
A Maclean-Hunter publication
five dollars a year

NEW PRODUCTS REVIEW

+125° C

a major



breakthrough!

−55° C

new BOMAC extended temperature gas switching tubes operate from −55°C to +125°C

for the first time

- **Fully reliable operation at all temperatures from -55°C to +125°C**
- **Excellent recovery time** even at extremely low temperatures
- **Leakage rate safely within specs** even at extremely high temperatures
- **Eliminate external heating or cooling systems:** save power, weight, space
- **No sacrifice of electrical charatceristics**
- **Fully life tested:** meet all requirements
- **Complete line for all frequencies:** physically interchangeable with present tubes

Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference cavities; crystal protectors; silicon diodes; magnetrons; klystrons; duplexers; pressurizing windows; noise source tubes; high frequency triode oscillators; surge protectors.

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Bomac LABORATORIES, INC.

Salem Road, Beverly, Massachusetts

March 1959

Volume three, number 3

CANADIAN ELECTRONICS ENGINEERING

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***our cover design** — *What can you say about a review of new products? We left the question with artist Kleefeld and let him present his own interesting interpretation for the March cover.*

New Power Tetrode!

CR 192 VHF POWER TETRODE

REPLACES TYPE 6166

FIELD TRIALS PROVE

LONGER TUBE LIFE

Type CR192 is a forced-air cooled V.H.F. Power Tetrode for use in television and other broadcasting applications at frequencies up to 220 Meg.—has coaxial electrode structure designed for use with coaxial circuits.

CR192 is a direct replacement for type 6166 except it has larger filament posts designed to reduce heating at the filament connectors. Possibility of poor contact and overheating of filament supports is lessened—giving longer tube life. Adapter filament sockets are supplied with each tube free of charge.

Screen support has been designed to reduce the capacity of the anode-to-screen shield at a critical point where high voltages under low load conditions produce catastrophic failures.

Reports from extensive field trials demonstrating the ease of operation and extended life of the CR192 prove Marconi's superior manufacturing techniques and careful quality control. Write today for complete information.

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ELECTRONIC TUBE AND COMPONENTS DIVISION
830 BAYVIEW AVENUE, TORONTO, ONTARIO

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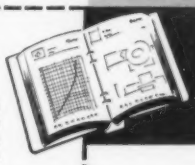

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Ian R. Dutton, BASC, MEM. I.R.E., P. ENG., *associate editor*

Michael Fallon, *Montreal editor*

Arthur R. Joy *British Columbia editor*

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J. W. Sargent, *sales promotion manager*

L. Martin, *Eastern advertising representative*

Murray R. Mark, *West Coast manager*

George W. Gilmour, *manager, industrial publications*

J. L. Craig, *director, business publications*

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Indexed in Engineering Index.

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Member Business Newspapers Association BNA

contributors and special articles in this issue:

When transistors were introduced the popular press waxed eloquent and predicted the early demise of the familiar tube. Engineers were a bit more realistic in their forecasting and saw a gradual displacement of some tube types as new transistors were developed.

Now, **D. S. Simkins** (On behalf of the electron tube) helps to set the record straight by explaining some of the important qualities of new tube designs.

Mr. Simkins, born in Surrey, England, has had 16 years experience with Mullard Radio Valve Co., on development, manufacture and application of special-purpose thermionic vacuum tubes. After an additional three years' development work on high-frequency heating with tube-generated energy, he came to Canada. That was in 1954 when he joined Rogers Electronic Tubes to develop transmitting and special-purpose tubes.

If you see any vintage automobiles gathering dust in some dark corner you could do Mr. Simkins a favor by informing him. He collects such cars for a hobby.

Just to keep the March issue of CEE in reasonable balance **Alfred M. Hase** (How to select semiconductor rectifiers) has given some good design information on semiconductors.

Mr. Hase is a graduate of the engineering school (electrical) of Meissen, Saxony, Germany. Prior to coming to Canada he was employed in a research capacity with Siemens Schuckert, Pretzfeld, Bavaria. He is the owner of several patents pertaining to the rectifier field.

In 1951 Mr. Hase came to Canada to do analogue computer research at Computing Devices of Canada Ltd., Ottawa. At present he is research and development engineer for Canadian Line Material's Rectronic division.

Mr. Hase was an active ham operator at one time, but has given up this pursuit temporarily to devote his time and energy to the raising of two children.

The main feature of this issue is a review of new products introduced into the Canadian electronics market during the past few months. The editorial staff of CEE has made a general survey in Canada, through manufacturers and representatives, to present a broad selection of materials, components, instruments and electronic equipment.

Before any product can reach the market a great deal of research and engineering work is involved. Another feature in this issue (Military component development in Canada) tells how the Electronic Component Research & Development Committee of DRB is working with the universities, government laboratories and industry in this field.

JONES & MORRIS

Hase

Simkins

By using the SHF Communications band and new, much smaller components, Westinghouse has developed a powerful yet compact MICROSCATTER system. Two MICROSCATTER components are shown above: The 2 K.W. Klystron Tube (right) and a model of the microwave block.

"Here's how we put Microscatter on wheels!"

Now, Westinghouse has successfully reduced the size of microwave scatter—by developing an SHF system! And now, all radio equipment for a 5,000 mc. quadruple diversity *repeater* can be mounted in a 40-foot truck trailer.

For voice, teletype, television, facsimile and raw radar video . . . this advanced MICROSCATTER gives you high quality SHF transmission to points 100 to 200 miles away!

WESTINGHOUSE MICROSCATTER also gives you

HIGH QUALITY TRANSMISSION with an extremely linear, wide band Modulator/Exciter.

LOW COST PER CHANNEL MILE . . . . due to minimum operating and maintenance costs . . . and low power consumption.

HIGH RELIABILITY of up to 99.99% . . . with quadruple diversity.

SMALL, NARROW-BEAM ANTENNAS, from 8 ft. to 28 ft. in diameter.

Here's MICROSCATTER on wheels! All radio equipment for a 5,000 mc. quadruple diversity repeater is easily mounted in a standard 40-foot trailer.

For complete information, phone your nearest Westinghouse office. Or write to Canadian Westinghouse Company Limited, Electronics Division, Longwood Road, Hamilton, Canada.

YOU CAN BE SURE... IF IT'S

Westinghouse

39C745

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News highlights . . .

CGE wins big USAF radar contract . . .

Canadian General Electric Company has been awarded a $9 million contract by DDP on behalf of the U.S. Air Force. It covers height-finding radars for the Pinetree Line and is additional to the $3.5 million contract for similar equipment placed by CGE by the RCAF last year. Sub-contracts will bring a substantial workload to many other suppliers.

Electronics industry too passive . . .

"If the electronics industry is to succeed in Canada it must become a contributive and adaptive one," Robert Story, vice-president and general manager of Radio Valve Co. Ltd., Toronto, told CEE on Canada's Electrical Day held in Vancouver February 11. "We have been far too passive to make progress; we must start standing on our own feet and doing things," he said.

Radio steady, But TV down again . . .

Distributor sales to dealers of radio sets totaled 574,490 units in 1958, very close to the 1957 figure of 577,930. Television receiver sales were, however, down 8½% at 430,980 units compared to 470,823 in 1957. Portable receivers strengthened in both fields: radio from 57,700 to 84,592, television from 49,062 to 65,838.

Magnetic tape industry expands . . .

The growth of the magnetic tape industry should continue at the healthy rate of about 35% in 1959, according to William C. Speed, president of Audio Devices, Inc. "This rate has been consistent over the past five years," said Speed, "and we see no reason to anticipate any major change." He also suggested that industry sales may very well reach $100 million within three years.

Satellite radios can be a problem . . .

Radio equipment in future instrumented satellites will probably be designed to transmit only on command from the earth. This will reduce the time during which already crowded frequency bands are used to relay information, compared with Vanguard's solar-powered transmitter which could continue cluttering a radio frequency for another 200 years.

Computer operation speeds increase . . .

Control Data Corporation's new 1604 transistorized digital computer has a memory access time of two microseconds and can add two numbers in one microsecond. In the analogue field, Beckman Instruments' Berkeley Division claim that their new techniques permit 100 times the speed and twice the accuracy of conventional analogue instruments; they are being applied in a simulator for the Bomarc weapon system to be supplied to Boeing Airplane Co.

BBG to check programming standards . . .

Operators of seven a-m radio stations are to be called before the Board of Broadcast Governors March 18 to show cause why their licenses should be renewed. The stations are: CKRN, Rouyn; CKOY, Ottawa; CKWS, Kingston; CKEY and CHUM, Toronto; CFPA, Port Arthur; and CKNW, New Westminster. It is understood that this action relates to the serious view recently taken by the Board of stations which almost exclusively broadcast news bulletins and recorded music.

Complete SY-30 illustrated

Industrial design by Dresdner

There IS something *NEW* in Mobile Radio!

The SYSTCOMS SY-30 150Mc/s Mobile Radiotelephone — the smallest, lightest 30-watt unit available **anywhere**

Features:

- Transistorized power supply and heater voltage regulator.
- Available wide band or split channel (simple field conversion).
- Single, dual or triple channel.
- Meets or exceeds all DOT or EIA specification requirements.
- Underdash mounting practical for all vehicles.
- Transmitter-receiver unit only 4″ high by 11″ wide by 12″ deep. Weight 15 lbs.
- All tubes operated CCS ratings. Fixed bias protection for transmitter power amplifier.

CANADIAN DESIGNED AND MANUFACTURED

Now in production. See your local SYSTCOMS dealer or write:

Distributorships open in some areas

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8235 MOUNTAIN SIGHTS AVENUE, MONTREAL • RE. 3-1814 • RE. 1-2515

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Electronics promotions reflect broadening activity

Sales manager of Potter & Brumfield Canada Ltd.

Mr. R. M. Brumfield, president, has announced the appointment of **Alan Laws** as sales manager of Potter & Brumfield Canada Ltd.

Alan Laws was born in Lloydminster, Saskatchewan, and received his education there and in England where he was at the beginning of the Second World War. Rather than return to Canada to enlist, he joined the British Army and served with the Somerset Light Infantry Regiment, rising to the rank of major. He commanded a bomb disposal unit from the war's end until 1947. On returning to civilian life he took a position as an industrial relations officer and in 1949 joined Newman Industries Ltd. of Bristol, England, as publicity manager.

In 1954 he returned to Canada to become advertising and sales promotion manager of Leland Electric.

Heads up engineering department

The appointment of **Murray T. Douglas** as manager, engineering department, at the Canadian Westinghouse Company's Electronics Division, Hamilton, has been announced. Formerly manager of manufacturing, he succeeds G. P. Adamson who was recently named Electronics Division manager.

Succeeding Mr. Douglas is Ewart O. Bridges, who moves up from the post of superintendent of industrial engineering.

Northern Electric appoints London plant manager

J. R. Houghton, assistant works manager of the communications equipment division of Northern Electric Co., Ltd., has been given the additional appointment of manager of the company's plant at London, Ontario.

Born in London, Ontario, Mr. Houghton was educated in Montreal at Westmount high school and McGill University, where he graduated in 1935 with the degree of B.Eng. mechanical engineering. He joined the company in 1935, as an engineer in the telephone division at Shearer Street.

In May 1943 Mr. Houghton became a supervisor in manufacturing methods engineering, in 1946 assistant superintendent of manufacturing methods engineering, in 1951 superintendent of manufacturing engineering and in 1956 engineer of manufacture, reporting to the vice-president, manufacturing and engineering. He was appointed assistant works manager in 1958.

Mr. Houghton is a member of the Engineering Institute of Canada, the Professional Engineers of Quebec, the Mechanical Section of the Canadian Standards Association, and the Institute of Administration.

Telephone company president

At a recent board meeting of Canadian (B. C.) Telephones and Supplies, **Mr. C. R. Hughes** was elected President. This organization, with headquarters in Vancouver, is affiliated with Automatic Electric (Canada) Limited, and performs installation and service work across Canada for products manufactured by Automatic Electric.

These new responsibilities are in addition to Mr. Hughes' present position as President of Automatic Electric (Canada) Limited, and Automatic Electric Sales (Canada) Limited. This will permit a closer integration of manufacture, sales, installation and service, covering equipment supplied by Automatic Electric to the communication field in Canada.

At the same meeting **A. W. Vaughan** was elected vice-president and general manager; and Mr. D. Armstrong was appointed secretary and treasurer with Mr. D. Campbell as assistant secretary and treasurer.

Wire and cable company appoints manager

Percy

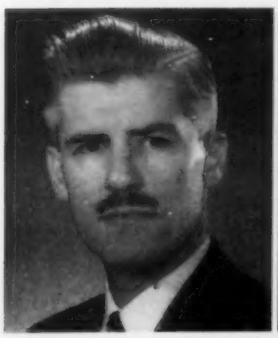
Smith

Mr. Carl P. Clare, recently appointed president of Industrial Wire and Cable Ltd., Toronto, has announced the appointment of **T. Harris Smith** as general manager. He is the former head of T. H. Smith Associates of Montreal.

Harold D. Percy of Brockville, Ontario, has been appointed assistant general manager and works manager.

Industrial Wire and Cable Limited, a Canadian firm established in 1937, was recently purchased by Universal Controls Incorporated, of New York, and will be operated as a wholly-owned subsidiary, manufacturing more than 75 lines of wire and cable, including aluminum and copper wire, drawn, woven, metallic sheathed and nonmetallic sheathed.

(Continued on page 57)



TOMLEN

Laws

ROYAL

Douglas

NAKASH

Houghton

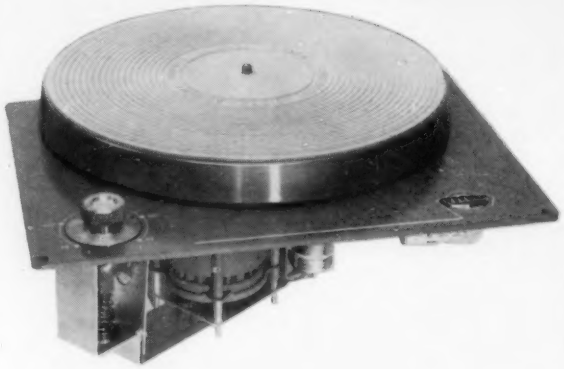
ASHLEY & CRIPPIN

Hughes

TURNTABLES

The HH12 is a three-speed turntable designed for use in semi-professional and home audio-system applications. Driven by a unique "inside-out" Hysteresis Synchronous motor, it provides reliable, trouble-free operation with performance characteristics equivalent to those of the finest professional turntables.

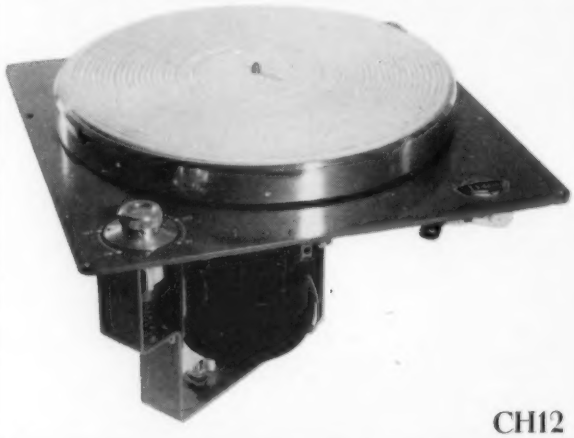
$125.00



HH12

The CH12 is a three-speed 12" commercial turntable engineered for professional use in broadcasting, television and recording studio applications. The drive system, which features a rugged 1/100 HP Hysteresis Synchronous motor, is designed for extremely high starting torque and constant speed operation under the most demanding conditions.

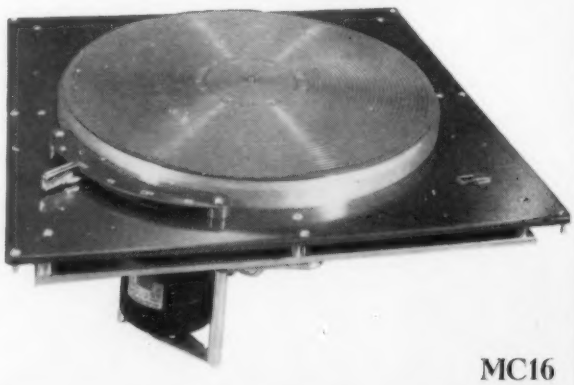
$160.00



CH12

The MC16 transcription turntable is a 16" unit designed to fulfill all requirements for three-speed operation in broadcasting, television and recording studio applications. Like the CH12, it incorporates a heavy duty drive system and Hysteresis Synchronous motor, and has been engineered for maximum ease of operation and dependability.

$285.00



MC16

McCURDY RADIO INDUSTRIES LIMITED, 22 FRONT ST. W., TORONTO 1, ONT.

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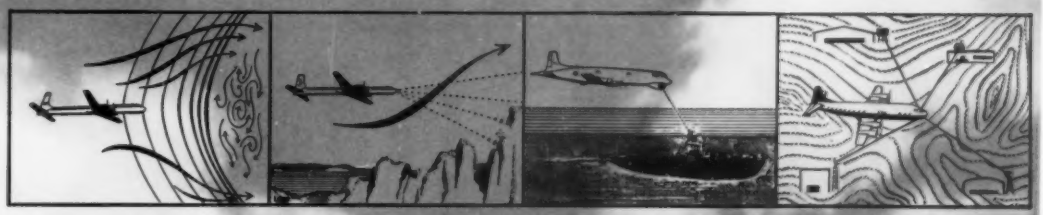


Electronic vision is needed...

SPERRY supplies it!

Multi-purpose airborne radar is just one of the many developments demanded by modern flying conditions. Sperry APN-59 fills four important military needs — storm warning, navigation, search and coded beacon identification. In extensive military service on this Continent, the APN-59 weighing only 175 pounds, is being manufactured at Sperry's Montreal plant for the Royal Canadian Navy.

This is one more example of the versatility of Sperry engineers in the field of electronics.

SPERRY

SPERRY GYROSCOPE COMPANY OF CANADA, LTD.

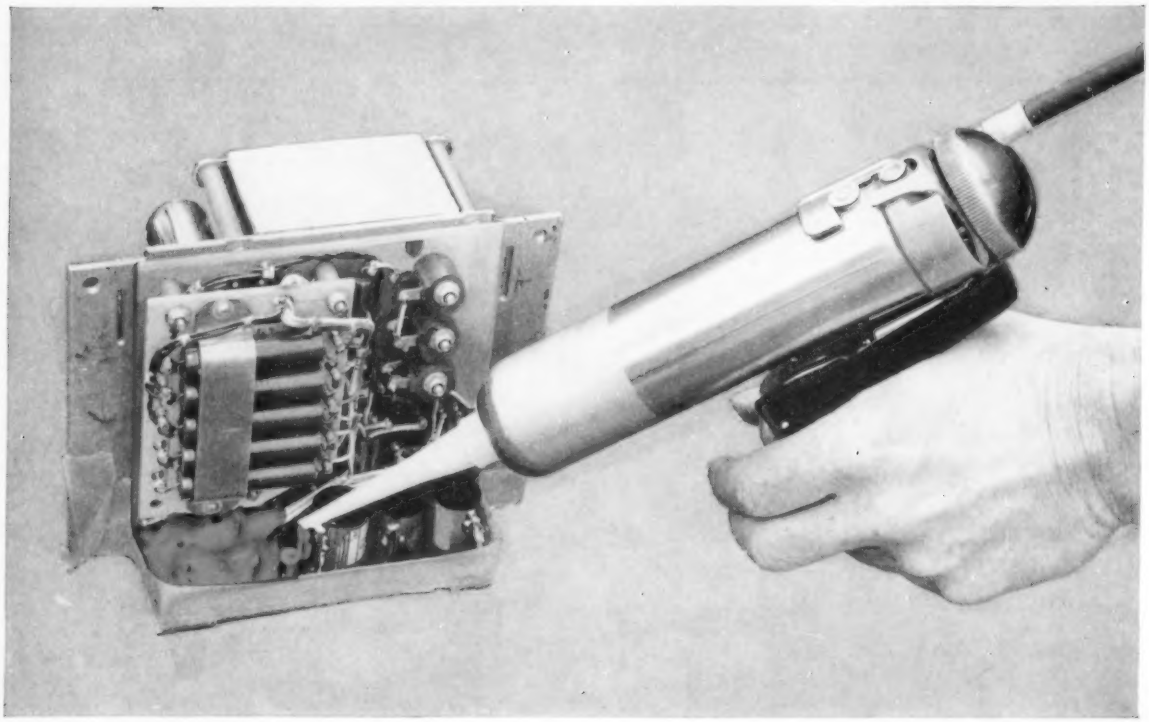
P. O. Box 710 • Montreal, Que.

Design better products with

SILASTIC RTV

SILICONE RUBBER

...seals and cushions delicate circuits



High impedance circuits in Northrop's Snark missile are coated with Silastic RTV for protection against moisture and vibration at temperature extremes. Silastic RTV is easy to apply . . . vulcanizes at room temperature.

TYPICAL PROPERTIES OF SILASTIC RTV

Temperature range, °C	—70 to 260C
Dielectric strength, volts/mil	300 to 500
Surface resistivity at 50% Relative humidity, ohms	2.8×10^{13}
Dielectric constant, 10^5 cycles per second	2.5
Dissipation factor, 10^5 cycles per second	0.003

Sensitive electronic components are sealed against moisture and cushioned against vibration with a coating of Silastic* RTV, the Dow Corning silicone rubber. Silastic RTV forms a rubbery silicone solid in 24 hours at room temperature. Stays resilient from —70 to 260 C. This "do-it-yourself" material is used for a wide range of encapsulating, potting and caulking applications. Write for free sample and complete information.

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC.

*T.M.REG.

first in silicones

DOW CORNING SILICONES LTD.

TIPPET RD., DOWNSVIEW, TORONTO, ONT.

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IRE International will hold fall meetings in Toronto

A fall executive meeting of the Institute of Radio Engineers International will be held in Toronto on the first day of the 1959 IRE Canadian Convention and Exposition. It will be followed on the second and third days by a board meeting of the organization.

Twenty directors and officers, including the eight Regional Directors, are expected to participate in these executive sessions.

Papers are now being submitted for possible presentation during the convention, which will be held on Oct. 7, 8 and 9 in the Automotive Building, Exhibition Park. Authors should first submit in duplicate 500-word summaries of their papers to Mr. Don K. Ritchie, chairman, Technical Program, IRE Canadian Convention, 1819 Yonge St., Toronto.

To broaden the scope of the exposition in 1959, invitations are being sent to scientific agencies of overseas governments as well as overseas commercial firms in the electronics and nucleonics fields.

Correction

Applied Electronics, 434 Church St., Toronto 14, was incorrectly named "Allied Electronics" in our February issue. The company's telephone number is CLifford 1-8451.

New buildings for London and Toronto firms

A $200,000 expansion program will shortly be under way at the Bach-Simpson Ltd. plant in London, Ont. The additional 12,000 sq. ft. of floor space will be shared with the sister company, Welwyn Canada Ltd.

Welwyn, which exports most of its production of resistors and other components to the U. S., also plans to add a further area to its plant later this year.

Electro Sonic Supply Co. Ltd., Toronto, will more than double their store and showroom facilities when a new four-story $250,000 addition is completed next to their present building at 539 Yonge St.

Lake Engrg. moves and adds new principals

Lake Engineering Co. Ltd., manufacturers' representatives, have moved to larger quarters at 123 Manville Rd., Scarborough, Ont.

Companies recently added to Lake's roster of principals include:

Capacitors of Canada Ltd. (paper tubular capacitors).

ITT Components Division of International Telephone & Telegraph Corp. (silicon and selenium rectifiers, tantalum capacitors, hermetic seals; Federal transmitting, traveling wave and image storage tubes; Kuthe hydrogen thyratrons).

Microdot, Inc. (microminiature coaxial cables, connectors and assemblies).

$3 million plant for Northern Electric

Construction will commence in the next few weeks, with completion scheduled for early 1960, of a manufacturing plant and offices for Northern Electric Co. Ltd., near London, Ont.

The company plans to manufacture telephone sets of all types and other lines of associated products. When operating at full capacity there will be employment for about 1,000 people.

Montreal company moves into new offices

New plant and offices of I T & T Electronics Service Co. of Canada Ltd. are located at 5796 Ferrier St., Town of Mount Royal, Que. I T & T Electronics is the Canadian field service arm of International Telephone & Telegraph Corporation.

Sales agent for Bakelite Co.

Bakelite Company, Division of Union Carbide Canada Ltd., has appointed National Fibre Co. of Canada Ltd. as exclusive sales agent for "Bakelite" brand laminated plastic products.

The primary products are manufactured by Bakelite Co.; National Fibre will sell sheets, rods and tubes and produce fabricated parts.

(Continued on page 58)

GILBERT A. MILNE

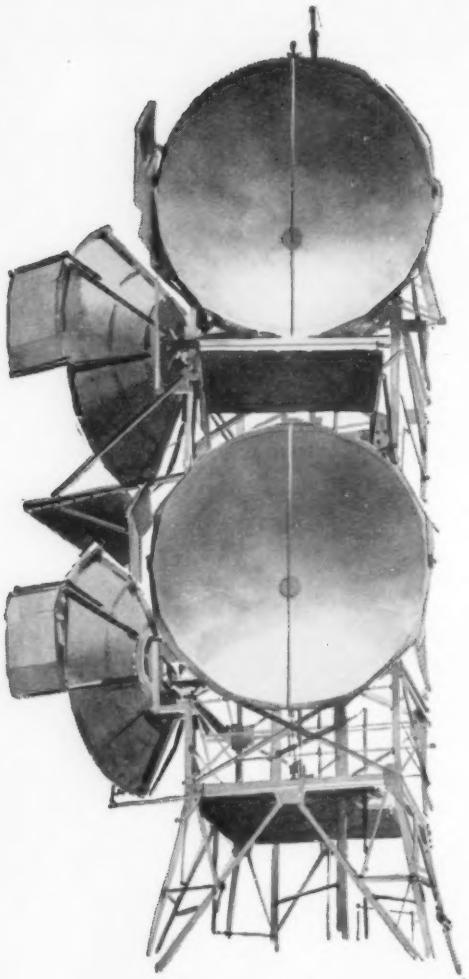
Members of the 1959 IRE Canadian Convention Executive Committee discuss plans for the October event.

Seated (l. to r.): A. P. H. Barclay, IRE Region 8 director; H. W. Jackson, recording secretary; Eric L. Palin, general chairman; Fred J. Heath, vice-chairman; Grant Smedmor, convention manager.

Standing (l. to r.): Don K. Ritchie, chairman, technical program; S. F. Love, exhibit award committee; George Armitage, chairman, exhibits; Ron G. Bullock, chairman, social activities; H. F. Shoemaker, chairman, IRE Toronto Section; Tom Purdy, Region 8 liaison; A. Jones, chairman, advertising and publicity; T. M. Lynd, chairman, finance; L. M. Price, chairman, registration and reception.

Absent at time of photograph were: Dr. George Sinclair, past general chairman; H. Ross Smyth, chairman, exhibit award committee.

STC LEADERS in microwave radio systems



STC pioneered the first "micro-ray" telephone and teleprinter transmission across the English Channel in 1931 and installed the first major television link in Europe in 1952.

Thousands of route miles of STC microwave telephone and television links are in service all over the world.

Experience gained in the planning, the manufacture, and the installation of S.H.F. links throughout the world makes *STC the leaders in microwave radio systems.*

7000 Mc/s S.H.F. LINK

STC 7000 Mc/s F.M. S.H.F. radio link is designed for use on feeder routes and is capable of carrying several telephone supergroups or television. Facilities can be provided for interworking with other radio links or with coaxial cable systems.

PORTABLE S.H.F. LINKS

This equipment is light in weight and is quickly and easily assembled on site.

The technical skill and expert advice of STC engineers are at your disposal.

Standard Telephones and Cables Mfg. Co. (Canada) Ltd.

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AN ITT ASSOCIATE

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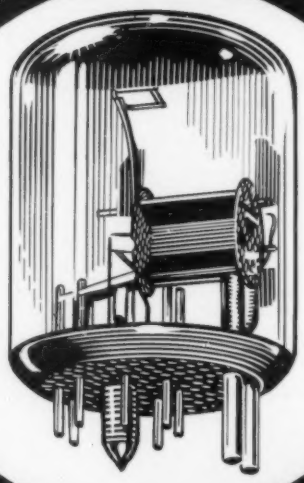
THE NEW QQE 04/5 TRANSMITTING DOUBLE TETRODE—Specially designed as an R.F. power amplifier or tripler in mobile high frequency ranges up to 960 Mc/s and in other R.F. applications up to 1000 Mc/s. The Philips QQE 04/5 provides 5 Watts *into the load* with a plate voltage of only 250 volts. Designed with a modified "frame-grid" construction producing such features as high mutual conductance, short transit time, small internal capacitances, low losses and low internal impedance.

Rogers wide range of quality communications tubes are finding more and more applications in all types of professional equipment. For greater reliability and lower maintenance costs, specify Rogers.



ROGERS

electronic tubes & components

A DIVISION OF PHILIPS ELECTRONICS INDUSTRIES LTD.

116 VANDERHOOF AVENUE, TORONTO, ONTARIO / BRANCHES: MONTREAL, WINNIPEG, VANCOUVER

★ Rogers Electronic Tubes are sold through Canada's Independent Electronic Parts Distributors

a new 260

Series III

— with improved sensitivity and added convenience, at a new low price.

For 20 years the famous Simpson 260 has become a by-word in circuit analysis and measurement. Still maintaining its fine reputation for quality and the traditional Simpson care and attention in every detail of design and manufacture — the 260 is now available in a new series to keep up with our changing times. The Series III 260 uses printed circuits for added reliability and ease of service. Increased sensitivities are provided at no sacrifice in reliability; added ranges, and a unique scale layout to improve readability.

Best of all — a **new low price** making the finest in measurement available to all sizes of pocket books — all made possible only by complete **Canadian** manufacture.

RANGES:

D.C. Current. From 50 Microamps to 10 Amps in 6 ranges.

D.C. Volts (20000 ohms/volt). From ¼ volt to 5000 volts in 7 ranges.

A.C. Volts (5000 ohms/volt). From 2.5 volts to 5000 volts in 6 ranges.

D.C. Resistance 0-2000 ohms to 0-20 megohms in 3 ranges.

Polarity reversing switch, volume level (decibel) and DBM ranges.

Price — tax included **$54.50**

The long tradition of fine instrumentation of the Model 260 is now extended to the custom-engineered Model 270, providing increased accuracy, a mirror scale and movement overload protective service, along with full performance data. Write for further details. Priced at $62.50.

4-8333

Bach-Simpson LIMITED

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IN U.S.A.: SIMPSON ELECTRIC COMPANY, 5200 W. KINZIE STREET, CHICAGO 44, ILLINOIS

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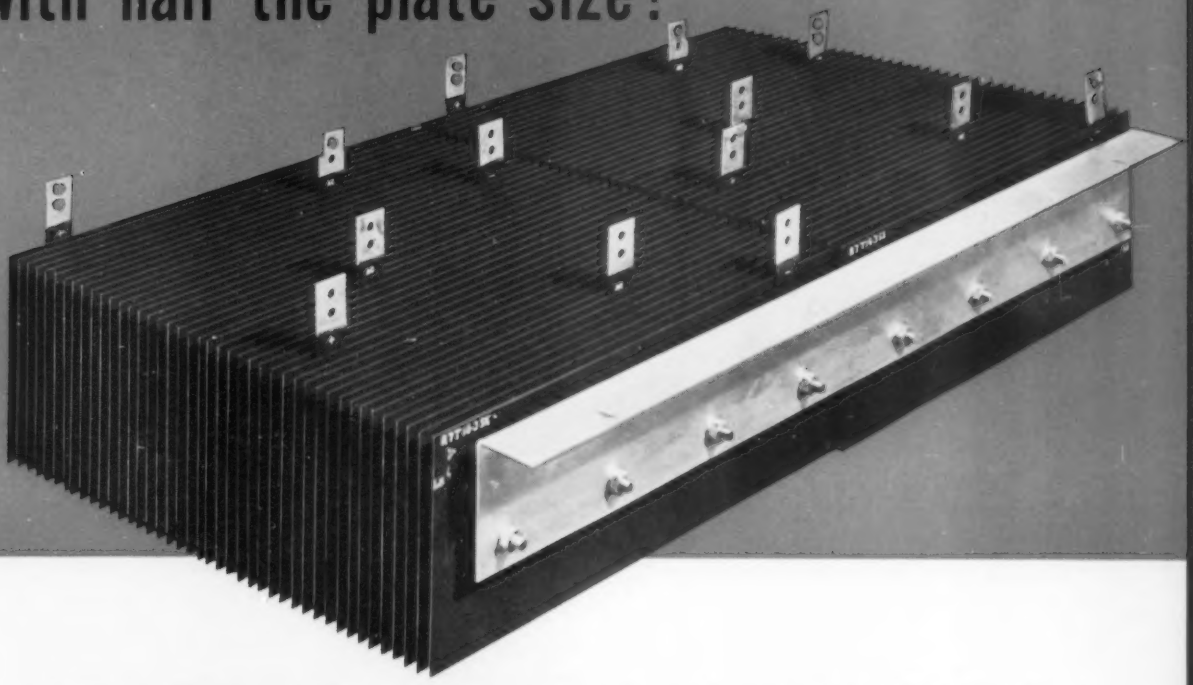
CLM'S New (HCD) Selenium Stacks deliver normal current ratings with half the plate size!



This machine deposits selenium under high vacuum on base plates.

A manufacturing process, recently developed by CLM, has made it possible to use the rectifying properties of selenium more fully. CLM rectifiers will carry twice the current per unit area of conventional selenium rectifiers, because of their superior electrical characteristics, extremely low losses and high efficiency. The new technique uses specially developed high vacuum equipment to deposit a thin selenium layer of great uniformity on the base plate. It also features a new rectifier junction of a p-n structure. Accelerated life tests indicate stable performance of the new rectifier stacks and a life expectancy of 100,000 hours.

Current ratings are approximately double those formerly established by NEMA. CLM (HCD) selenium stacks are available in 13 different plate sizes ranging from 1″ x 1″ to 6″ x 16″. Efficiencies are exceptionally high, over a wide range of load.

CLM-HCD-SELENIUM stacks cannot be destroyed by transient currents and voltages and, therefore, do not need additional protective devices. They can be operated within a temperature range of —60°C to +75°C ambient with negligible changes of reverse leakage and forward drop.

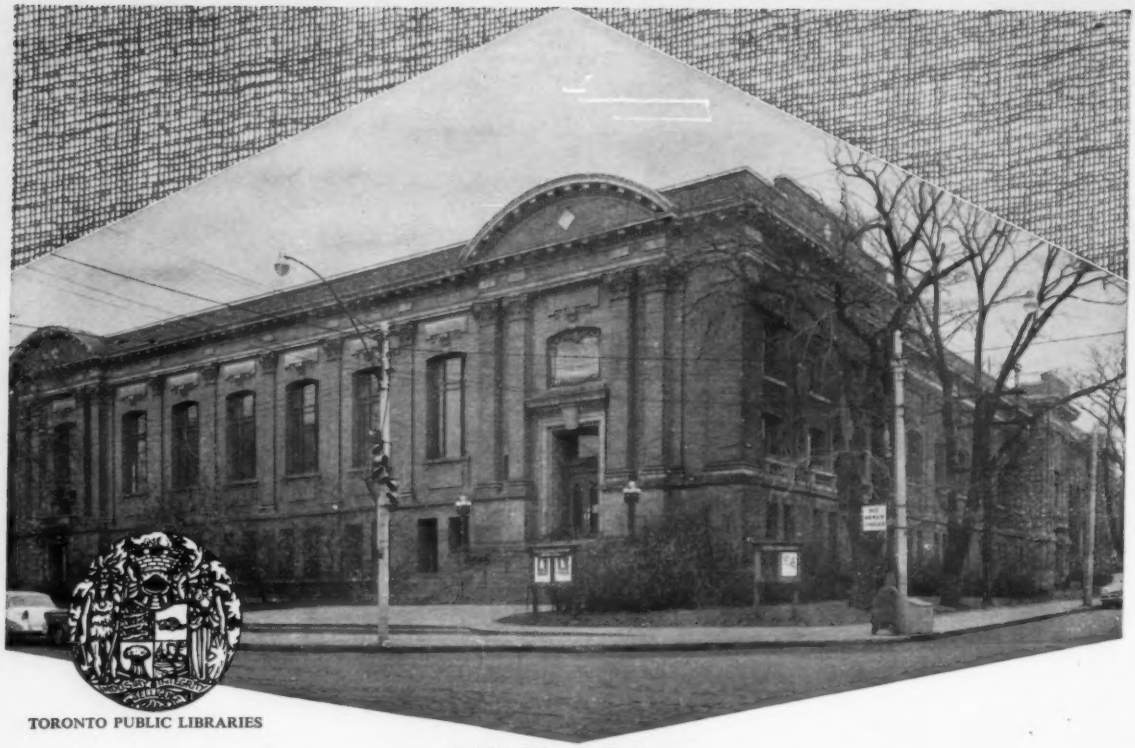
Extra HCD plates are available at 3 and 4 times NEMA for special applications.

For bulletin SR-15-1 write Jack West, Product Manager, Rectronic Division, Canadian Line Materials Limited, Toronto 13, Canada.

HIGH CURRENT DENSITY (HCD) SELENIUM RECTIFIERS

CANADIAN LINE MATERIALS LIMITED

TORONTO 13, CANADA



TORONTO PUBLIC LIBRARIES

Public Library Reports

BUSINESS PAPERS SUPPLY OVER 75% INFORMATION THAT COMPANIES REQUIRE

Last year 58,000 people used The Hallam Room at the Toronto Public Library. On file there are issues of several hundred Canadian business papers and house organs. A survey of 6000 firms in Toronto showed 45% consult the library 1 to 5 times a year and over 75% of the information they want is found in business and trade publications. The story is much the same in most large Canadian libraries.

The McGill University Library School Documentation Seminar 1958 stated: "The pre-eminent position given to business publications has long been recognized . . . libraries have for many years devoted attention to providing the widest access to business publications".

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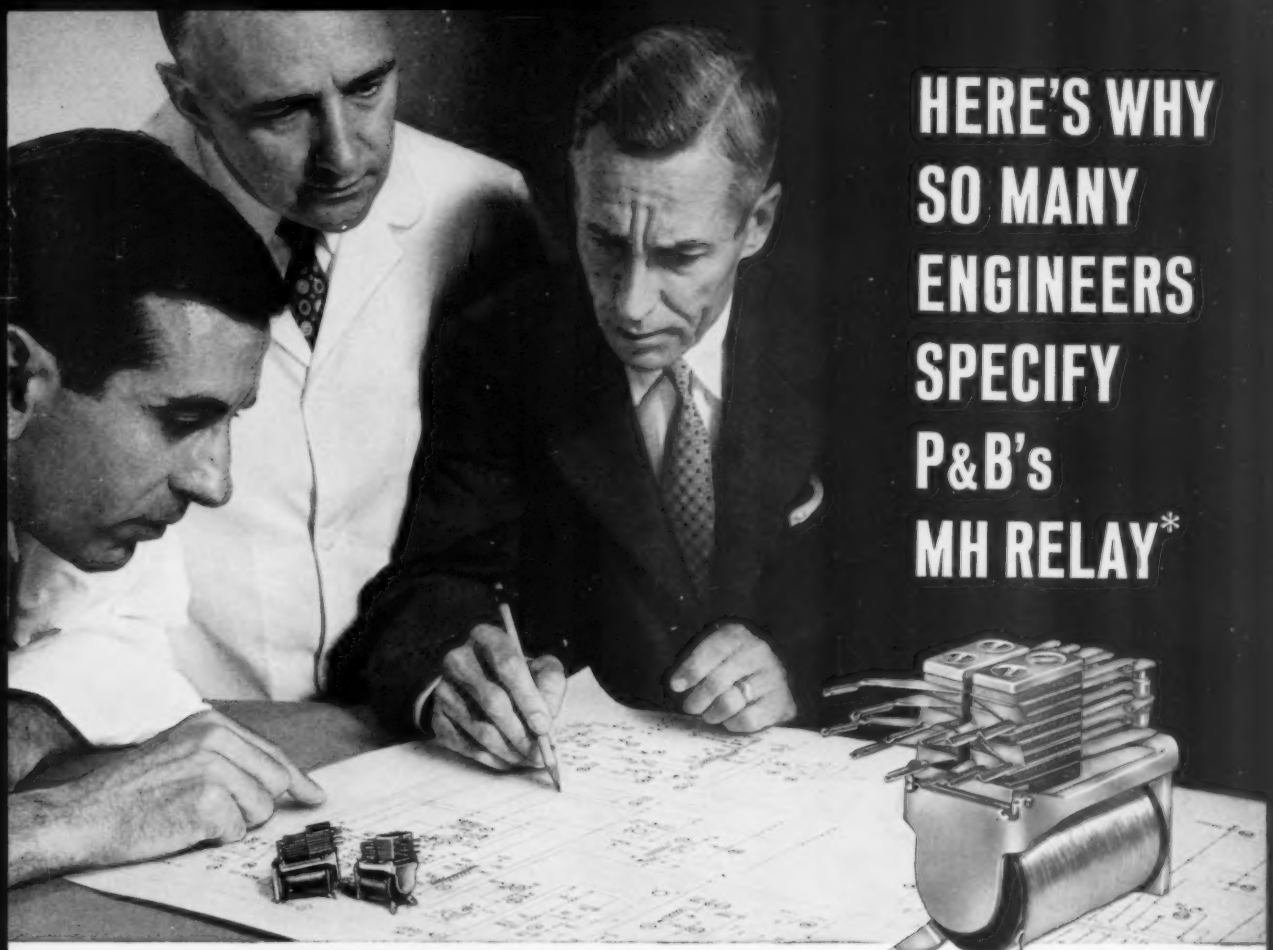


HERE'S WHY SO MANY ENGINEERS SPECIFY P&B's MH RELAY*

*AND VARIATIONS OF THIS BASIC STRUCTURE SHOWN BELOW

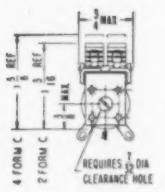
Shown with printed circuit terminals

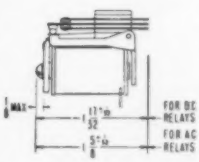
VERSATILITY and adaptability

are prime reasons why designers have made the MH a P&B best seller. This relay series, for example, does yeoman duty in such diverse applications as jet aircraft, street lighting equipment, computers and missile ground controls.

When multiple switching is required...when size, weight, long life and reliability are critical ...our MH relay can usually fill the bill. It's RIGHT for countless jobs, often at countable savings.

Let us send you complete information about this miniature telephone-type relay and the variations we've evolved for special applications. Write or call today.





ENGINEERING DATA/MH RELAY

Insulation: Laminated phenolic.

Insulation Resistance: 100 megohms minimum.

Breakdown Voltage: 500 volts RMS between all elements.

Shock: Up to 30g.

Vibration: Up to 10g from 55 to 500 cps.; .065" max. excursions from 10 to 55 cps.

Ambient Temperature: −45°C. to +85°C. −(65°C. to +125°C. on special order).

Weight: 2½ oz. max. (open relay)

Pull-In: Approx. 75% of nominal voltage.

Pull-In Speed: Approx. 15 ms.

Drop-Out Speed: Approx. 10 ms.

Terminals: Pierced solder lugs; special lugs for printed circuits, taper tab (AMP #78).

CONTACTS:

Arrangements: Up to 9 springs per stack.

Material: ⅛" silver; also Palladium or gold alloy.

Load: Dry circuits to 5 amps @115V AC resistive.

COILS:

Resistance: 22,000 ohms max.

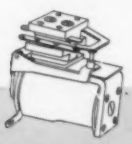
Power: 100 milliwatts per movable minimum to 4 watts at 25°C. max. (200 mw. min. to meet max. shock/vibration spec.)

Duty: DC: Continuous. AC: Intermittent (2 pole relay max.)

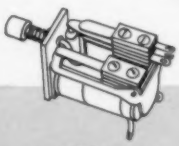
Voltages: DC: Up to 110 volts. AC: Up to 230 v. 60 cycles.

Current: 2.5 ma to 10 amps DC.

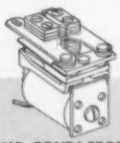
P&B STANDARD RELAYS AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



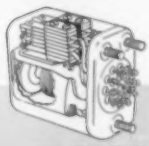
MC FOR RF SWITCHING
For RF switching where intercontact capacitance losses must be minimized. Ceramic contact spacers.



MA LATCHING
Electrical latch; mechanical reset. Small, versatile and offered with selection of contact arrangements.



MB CONTACTOR
Contacts rated 60 amp. 28 volts DC non-inductive. Will carry 150 amp. surge for a duration of 0.3 seconds.



MH SEAL-TEMP
Features sealed coil to minimize contact contamination. Available as hermetically sealed relay only.

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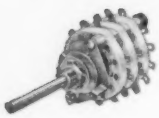
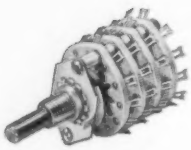
GUELPH, ONTARIO

Solving switch problems fast...

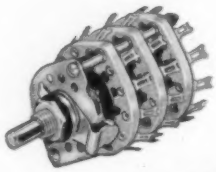
your job...and Centralab's



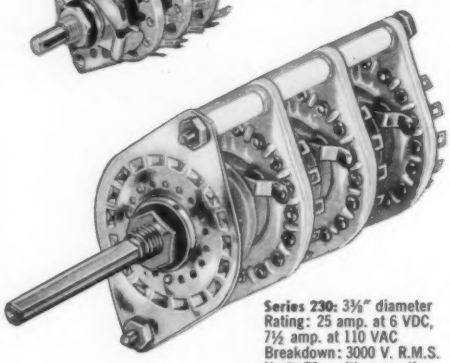
Series 100: 1⁵⁄₁₆" diameter
Rating: 0.5 amp. at 6 VDC,
100 ma at 110 VAC
Breakdown: 750 V. R.M.S.
Up to 12 positions/section



Series 20: 1⁵⁄₁₆" diameter
Rating: 2 amp. at 15 VDC,
150 ma at 110 VAC
Breakdown: 1500 V. R.M.S.
Up to 12 positions/section



Series 275: 1⅞" diameter
Rating: 2 amp. at 15 VDC,
150 ma at 110 VAC
Breakdown: 1500 V. R.M.S.
Up to 23 positions/section



Series 230: 3⅜" diameter
Rating: 25 amp. at 6 VDC,
7½ amp. at 110 VAC
Breakdown: 3000 V. R.M.S.
Up to 24 positions/section

Your switch problems can be solved quickly and efficiently at CENTRALAB. No matter how unusual or difficult the switch, you can get samples fast, quotations fast, and production fast! This is a result of years of specialized experience and superior facilities for designing and manufacturing a wide variety of switch types.

Typical of the extensive range of units available to you are the four CENTRALAB ceramic section switches shown here. These switches, and many others, are also available with phenolic sections, for economy applications, or where a larger number of positions is required.

DESIGN AIDS FOR ENGINEERS

CENTRALAB'S unique Switch Visualizer, which simulates actual switch operation, will help you simplify and speed up switch design. Used in conjunction with our detailed layout sheets (available for all CENTRALAB switch types), they greatly facilitate your job in switch design (and ours, too). Write for them today—along with a copy of CENTRALAB Switch Catalog 42-405.

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P-5917

VARIABLE RESISTORS • ELECTRONIC SWITCHES • PACKAGED ELECTRONIC CIRCUITS • CERAMIC CAPACITORS • ENGINEERED CERAMICS

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PROBLEM: Make conductors that stay "alive" at Mach 30

Equipment is so closely packed within missiles and supersonic aircraft that wires and electronic gear scarcely have a chance to dissipate their own intense heat . . . compounded by the sizzling heat built up as the crafts' thin shells knife through the air.

Developing high temperature insulations for these applications—for countless other applications where miniaturization of equipment has created hotter running conditions—is a major project at Canada Wire. An example of the dramatic breaks being made in heat barriers is the development of TEFLON*, an insulation capable of continuous service at temperatures as high as 250°C.

At all times, over fifty new materials are actively being investigated at the Canada Wire research centre. It is insurance that your future needs will be met without costly delay . . . that all Canada Wire and Cable Company Limited products are always the highest possible quality at the lowest possible cost.

*TEFLON is a Du Pont trademark

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TECHNICAL BULLETINS IN QUICK-READING FORM

PRODUCT INFORMATION LETTER
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PRODUCT INFORMATION LETTER
FLEXIBLE CORDS • FIXTURE WIRES • APPLIANCE WIRES

58-23

Canada Wire

PRODUCT INFORMATION LETTERS

MAGNET WIRE (Letter M.1). Lists the extensive range of Magnet Wires with a breakdown of the 21 insulating materials available, together with their thermal classifications, specifications and characteristics.

MAGNET WIRE (Letter M.2). Gives helpful details on the most recent magnet wire packaging developments and complete specifications on three new types of magnet wire not included in Letter M.1: Polytemp (rectangular and square), Polysol-N (Polysol-Nylon) and Polybond (Polysol Bondel).

FLEXIBLE CORDS, FIXTURE WIRES, APPLIANCE WIRES (Letter G.1). Contains complete reference tables giving type of insulation, number and size of conductors, insulation thickness, and the maximum operating temperatures and voltages.

All the relevant facts of these Canada Wire Products at your finger-tips. Concise information which can help you in your business. Fill in the coupon below for this reference material and for future Canada Wire Product Information Letters.

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I am particularly interested in.....
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Name..... Title.....

Company.....

Address..... Province.....

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TRADE MARK REGISTERED

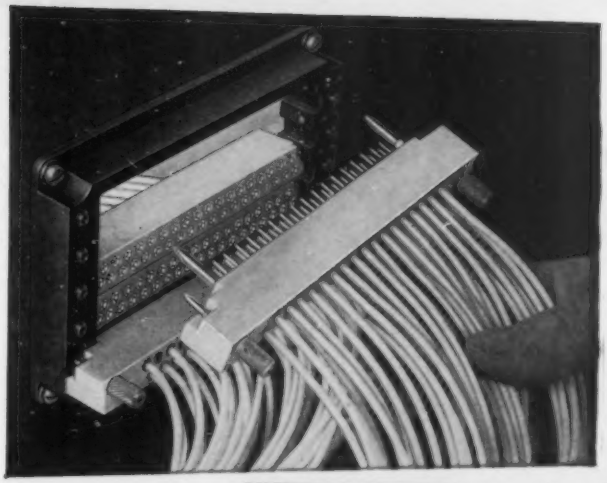
feed-thru, multiple insert

HYFEN®

connector

with crimp-type, snap-locked contacts

Makes possible the design of lighter and more compact equipment. Each insert holds 35 contacts. Frames available for 5 or 8 inserts.



crimp-type

MODULAR ELECTRICAL CONNECTORS

IN 3 NEW BASIC TYPES

Modular units by Burndy provide versatile, rapid and reliable answers to the problem of connecting a multiplicity of wires in relatively limited spaces. Crimped contacts—installed with any of several hand, pneumatic, semi-automatic or automatic tools—can be removed, re-inserted or replaced, providing the most complete flexibility in the connector field. Computers, ground-based radar, missile ground controls, and instrumentation are typical applications for Burndy modular connectors.

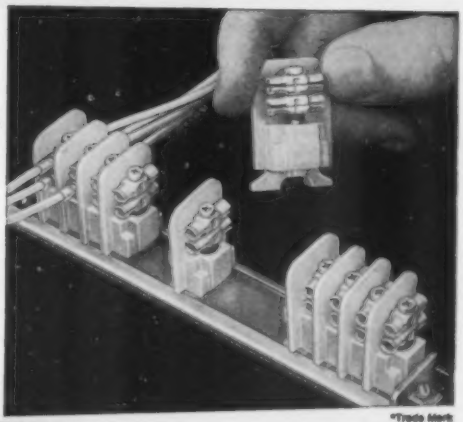
quick-disconnect or permanently connected

MODULOK*

terminal block

with snap-in, spring-loaded contacts

True versatility in a terminal block. 30 modules (2 or 4 tier) per foot. Twist of a screwdriver transforms quick-disconnect contacts to permanent connections.



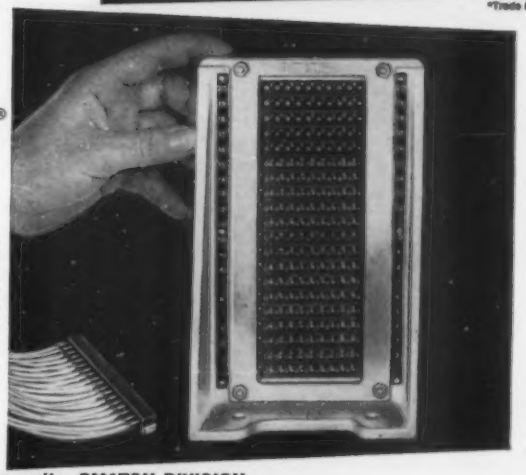
*Trade Mark

crimp-type, solid-shank

STAPIN®

taper pin contacts

Another Burndy contribution to the modular concept of assembling standard units to provide custom-fitted end products.



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This famous team's Engineer, Furnish and Install service assures you that the project is in the hands of experts from start to finish.

Why not find out *now* how the Big Team of Two can help *you* solve your communications problems.

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5916

AUTOMATIC AE CO ELECTRIC

ORIGINATORS OF THE DIAL TELEPHONE

GENERAL SYSTEM

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How will the Arrow affect Canadian electronics?

The final government decision has been made on the CF-105 Arrow supersonic interceptor and its Iroquois jet engine. Although it came a little earlier than forecast, it was what many of us had expected was inevitable in the circumstances—cancellation. But the suddenness of its effect certainly came as a rude shock.

Talks have been going on between the manufacturers and the Government. They hope to salvage some part of one of the major segments of Canada's aircraft industry. At the same time, hundreds of engineers and scientists are having their own talks—with prospective employers, from the U. S. in many cases.

What of the engineers and scientists in the electronics industry who have been retained—after the cancellation of Astra and Sparrow II—to work on stop-gap programs during the winter months? Surely they will now see an even bleaker future ahead and act accordingly, particularly since the stop-gap plan, which expires this month, has not been renewed.

Looking at the long-term prospects for Canadian electronics, we see a great gap torn in a most important area of application of new electronic techniques—the aircraft industry. Of course, we still have many problems to master by research and development in other areas, such as communications and industrial control systems. But if we are to retain the key technical personnel needed to solve these problems, Canada will have to get her share of the new defense development work that can provide them with the incentive to remain.

Industry and government must work together now to ensure that this happens.

What price competence?

The Civil Service Commission recently advertised the requirements of the newly formed Board of Broadcast Governors for a broadcast consulting engineer. The duties comprise acting in an advisory capacity on all technical matters concerned with broadcasting stations. The quoted salary range is $8,340-$9,420.

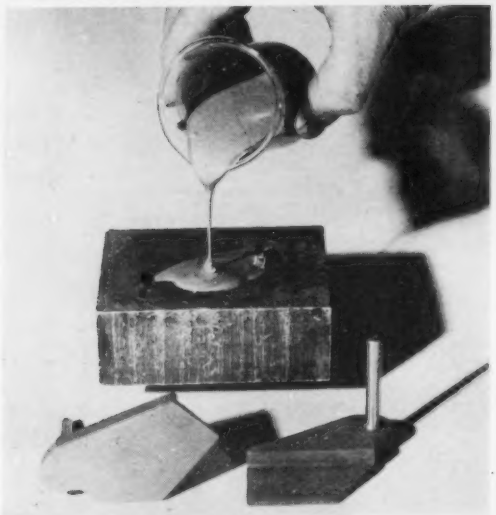
We wonder whether the Board really expects to get the kind of man they obviously need in this position for less than $800 per month. Or is it that they are prepared to accept a lower standard of qualifications and experience for the sake of saving a few dollars?

THE EDITOR

Components, page 24

Instruments, page 31

Equipment, page 35



Other products, page 39

New Products Review

To help our readers keep informed on the many new products produced in the electronics industry, CEE has conducted a general survey. Here is a broad selection of components, instruments, electronic equipment and other products that have been introduced to the Canadian market recently.

Components

Radial lead capacitors 50

The thin design and lead geometry permit axial, radial or edge mounting of these Vitromon type CY17C capacitors. The largest size in the series is 12,000 uuf at 50 to 300 vdcw. Dissipation factor is less than 0.0005 with a Q over 2,500. Insulation resistance is greater than 50,000; capacitance drift less than 0.05% with a tc of 115 ± 25 ppm/C from —55 C to +125 C. All units are within 5 ppm of one another.

1000 of the smallest of this series occupy a space of approximately 6 cu. in.

Aeromotive Engineering Products, Montreal.

Tantalum dielectric used in capacitor 51

The Astron Corp. Type TES subminiature metal-cased hermetically sealed capacitors use a solid tantalum dielectric and solid electrolyte. The capacitance range of this series is from 0.0047 uf to 47 uf, with average variation ±5% at 25 C. Dissipation factor is less than 0.06, leakage current at rated voltage and 25 C is less than 0.05 ua per uf per volt, or 2 ua, whichever is greater.

Charles W. Pointon Ltd., Toronto.

Circumaural earphones 52

Developed at the National Research Council, these earphones have liquid filled cushions which provide correct acoustic coupling to the ears and eliminate outside sound. Construction of the chamber accomplishes a variable impedance, eliminating intermodulation distortion and extending the frequency response.

Frequency response is 20 to 15,000 cps; flat to 12,000 cps, down 4 db at 15,000 cps. External noise attenuation is 40 db at 1 kc or higher.

Sharpe Instruments Ltd., Willowdale, Ont.

Thermal-shockproof capacitor 53

This miniature feed-through capacitor is designed for printed circuits and has been made thermal-shockproof to resist damage caused by high temperature solder dipping. Measuring 0.590 in. long with a mounting diameter of 0.155 in. the capacitor is stable over the temperature range from —67 F to +300 F. It is available in ratings, up to 2,200 uuf at 200 wvdc and is potted in an epoxy medium inside a tinned brass shell.

Telecomputing Corp., Los Angeles, Calif.

Multi turn potentiometers, 54

Spectrol Electronics Corp. has introduced 3 multi-turn potentiometers. Model 550 is a 3-turn wire wound potentiometer offered in ranges from 10 to 75,000 ohms with a linearity tolerance of ± 0.3%. It measures 7/8 in. in diameter. Model 870 is a 10-turn wire wound potentiometer available in ranges from 30 to 750,000 ohms and with a standard linearity tolerance of ± 0.3%. It measures 1 7/16 in. in diameter. Both these models have bodies made of moisture proof laminated phenolic and can be equipped with extra terminals.

Model 590 is a 10-turn, all metal potentiometer available in ranges from 25 to 120,000 ohms with standard linearity tolerance of ± 0.3%. Construction is machined aluminum with the helical coil directly against the case for maximum heat dissipation. It will operate over a temperature range of —65 to + 200 C and can withstand a relative humidity of 95%. It functions above 20g vibration from 55 to 2000 cps.

E. E. Whittaker, Arnprior, Ont

Synchro linvar 55

This Canadian made linear variometer is designed for use where an ac output voltage varying linearly with deflection is required. The linear relationship of ±¼% extends over the range ±85 deg. from the O output position. Model 11M16A1 is rated at 115 volts, 400 cps; Model 11M16A2 is rated at 26 volts, 400 cps. Both are housed in standard Bu-Ord size 11 synchro frames.

Muirhead Instruments Ltd., Stratford, Ont.

Sub-miniature potentiometer 56

Giannini Model 875 precision potentiometer has a linearity rated at ±0.1% of full scale. It weighs only 5/8 oz. and is 0.87 in. in diameter. Resistance ranges from 200 ohms through 100,000 ohms per section are available. The unit is wire wound, has survo mount, and up to 4 sections can be ganged on a common shaft.

Arva, Vancouver.

Series T pots 57

A complete redesign of the Helipot series T single-turn potentiometers has upgraded them electrically, mechanically and environmentally. Standard resistance range extends from 650 ohms to 100,000 ohms ±5%; ±2% available. Standard linearity tolerance is ±0.50%; ±0.20% available. Power rating is 1.2 watts at 40 C, derating to 0 at 125 C.

R.O.R. Associates Ltd., Don Mills, Ont.

For more information on New Product and Catalogue items, use Reader Service Cards on pages 69 and 70

Miniature variable resistor 58

This variable composition resistor, developed and manufactured in Canada, is available in type T with bushing mount and type V for standard 0.100 printed circuit layout (lugs spaced 0.200 in.). The outside diameter is only ⅜ in., and the resistors can be used under extreme environmental conditions as specified in MIL-R-94B.

Also available is a new ½-in. potentiometer with molded-in connections. It will meet the new specification RV-6.

Precision Electronic Components (1956) Ltd., Toronto.

Wirewound resistors 59

These precision wirewound resistors are available in values as low as 0.1 ohm at ±0.05%. Tested to 0.001% tolerance, each unit is calibrated on tinned copper leads. They are molded in epoxy resin which bonds with the winding forms and winding terminals.

International Resistance Co. Ltd., Toronto.

Laboratory standard resistors 60

Mid-Eastern Electronics, Inc. has developed certified laboratory standard resistors for use with their Megatrometer. Values available are 10, 100, 1000 and 10,000 megohms. Each unit is certified to 0.2% and is supplied with a temperature curve. They are mounted in Faraday Boxes which plug directly into the Megatrometer.

John R. Tilton Ltd., Toronto.

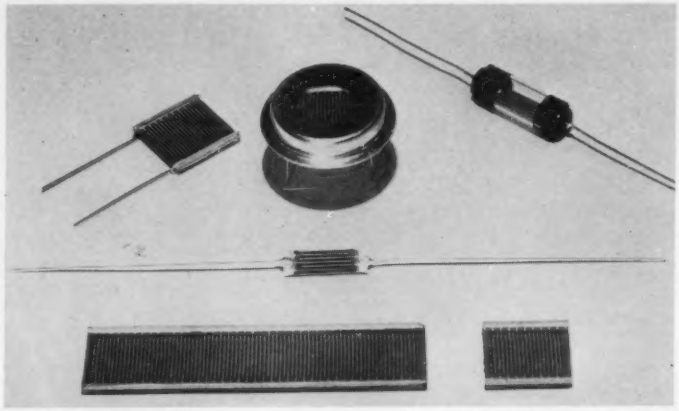
Miniature trimmer potentiometer 61

Variable micrometer type adjustment gives selection of resistance from 10 ohms to 150,000 ohms, on model W-10 miniature trimmer potentiometer. Power rating is 2 watts at 70 C, de-rating to 0 at 200 C. Outside case dimensions are 1.140 in. x 0.312 in. x 0.210 in. Average weight is 2 grams.

Atohm Electronics, Sun Valley, Calif.

High temperature potentiometer 62

The high temperature version of the Clarostat series 42 wire wound precision potentiometer is designed to operate at temperatures up to 230 C with a wattage rating of 0.25. Resistance change after



Photoconductive cells 63

Cadmium sulphide photoconductive cells feature several new physical shapes to meet common mounting problems. The unsealed types have the sensitive surface and electrodes in the form of a film on one side of the glass base. The head-on type is hermetically sealed with the cell behind a glass window. Another type is the tubular hermetically sealed cell.

The cells have approximately the same spectral response as the human eye. They are intended for use in 115 vac circuits but have a rating to 220 vac.

National Semiconductors Ltd., Montreal.

Components—cont.

255 hours at 230 C is less than 0.1%. Insulation resistance is 10 k minimum; resistance tolerance is ±5% from 1 ohm to 100 k; independent linearity is ±0.5%; noise is less than 5 microvolts.

Canadian Marconi Co., Toronto.

Telephone type relay 64

This modified version of the short coil TS telephone type relay features bifurcated contact arms with as many as 20 arms per relay (10 arms per stack). It operates on as little as 100 milliwatts per movable arm and can be furnished to operate on voltages up to 110 vdc. It will switch up to four amperes at 115 volts, 60 cps, resistive load.

Potter & Brumfield Canada Ltd., Guelph, Ont.

Rotary relay 65

The Couch Ordnance Inc. rotary relay CVE type 4C features a contact rating of 5 amperes at 30 vdc. It will operate at temperatures up to 125 C; vibration to 2000 cps at 20 G acceleration. It is hermetically sealed.

Leonard Electric Ltd., Toronto.

Miniature relays 66

Two new 4-pole double throw miniature relays operate under 100g, 11 millisecond shocks and vibration of 30 g to 2000 cps. They employ permanent magnets to achieve holding forces. Terminal headers at both ends of the relays permit mounting them in cable runs.

Type SF is conventional acting and type SK employs the magnetic latch principle. Both relays switch up to 2 amperes, 30 vdc resistive loads or 1 ampere, 115 v, 60 cps resistive loads.

Potter & Brumfield, Canada Ltd., Guelph, Ont.

New relay uses molded spring 67

Model TT and TS relays use standard single-pole, double throw spring combinations molded into a single compact assembly. The plastic matrix holds the springs in alignment. Up to six modules can be incorporated into a relay. Model TT is designed to meet specification MIL-R-5757C (Class A and B) Model TS meets MIL-R-6106C.

Ohmite Mfg. Co., Skokie, Ill.

Adjustable relay 68

The General Automatic Corp. series 100 relay has a removable dust cover to permit adjustment. A screw on the armature spring can be adjusted with a screwdriver to modify pick-up characteristics, contact pressures or power requirements. Pick-up and drop-out ratios may be set as high as 85% or as low as 10%. Standard coil resistances are up to 30,000 ohms and special windings to 100,000 ohms. Contact capacity ranges from 3 to 5 amps resistive. Sensitivity may be as low as two milliwatts per contact.

Electrodesign, Montreal.

Solenoid control valve 69

Half-inch Poppet pilot B type single and double solenoid operated control valves have been introduced by Hunt Valve Co. For use in air and hydraulic control. These valves have full half-inch flow (257 cfm at 100 psig). Instead of applying the force of the solenoid directly against the valve plunger, fluid pressure is used to operate the valve, permitting the use of smaller, shorter stroke solenoids than would otherwise be required. The valves are available in all customary ac and dc voltages.

J. B. Morrison Machinery Co. Ltd., Toronto.

Pressure switch 70

The Haydon series 1500 pressure switch is capable of sensing pressure levels from 0.5 to 4,000 psi merely by changing internal modular components. Eight switches will cover the complete pressure span. Calibration of each switch assembly is obtained by rotating the external pressure setting adjustment, which is then securely locked by two set screws. The switches meet specification MIL-E-5272A. An optional mounting bracket provides vibration isolation up to 2,000 cps and up to 50 g.

Philips Electronics Industries Ltd., Toronto.

Snap-action switches 71

Hetherington S2A series snap-action switches for manual and mechanically actuated use are rated at 20 amperes, 125/250 vac. They are available with any of eight actuator mechanisms: pin plunger, stub plunger, panel-mount plunger, leaf-spring, roller leaf, hinged lever, long-hinged lever, and short-hinged roller lever.

Leonard Electric Ltd., Toronto.

Push-button switch 72

The new line of Richards Electrocraft locking-type push-button switches mount within ⅝-in. centres. The switches are available in standard 3-ampere rating, but this rating may be increased with special contact materials. They are available in a wide variety of circuits.

R. C. Kahnert Sales Co., Scarborough, Ont.

Commutator switch 73

Commutator plate CP 427 incorporates rectangular contacts precision molded in SUPRAMICA 555 ceramoplastic. It can provide two rows of 180 contacts and one row of 90 contacts on a 3-in. diameter plate. The individual contacts are molded to within an accuracy of 0.0005 in.

In operation the plate has low noise; less than 10 microvolts from the mechanical action of the brush and a contact resistance of about 1/10 ohm.

Mycalex Corp. of America, Clifton, N.J.

Fully enclosed switches 74

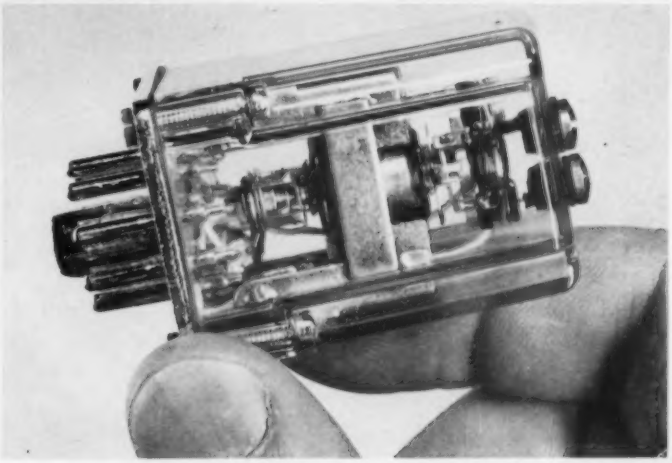
Unimax type A switches are designed for use in applications which require

Relay contacts are adjustable 75

Adjustable contacts, permitting easy changing of either control points or calibration, are now standard on the model 137 vhs non-indicating meter relay.

It offers the advantages of a standard locking coil meter-relay except dial indication. It will trigger control action on signal changes as small as 0.2 ua, or 0.1 mv, dc.

Assembly Products, Inc., Chesterland, Ohio.



fully enclosed, snap-action switches with quick-connect terminals. They are available with a variety of actuators and the terminals are suitable for solder or tape-tab connections. Mechanical life is rated in excess of 1,000,000 operations.

Aeromotive Engineering Products Ltd., Pte. Claire, Que.

Compound rotary switches 76

Circuit switching without relays can be accomplished with the Hetherington type WC-1447 switch. Six 15-ampere snap-action push-button switches are arranged individually around the periphery of an aluminum case. A cam coupled to the shaft holds five of the six switches in the operated contact position. As the shaft rotates, individual switches are successively transferred from the operated to the normal contact position. Cams may also be designed to operate more than one switch at a time.

A similar compound rotary switch, Hetherington Type WC-1433 is available for 12-position operation.

Leonard Electric Ltd., Toronto.

Isolating and audio transformers 77

Line regulating isolating transformer-type IR 300 is rated at an input of 115 volts, 60 cps. Output is tapped at 90 to 130 volts, 300 va.

Hi-fi output transformer has a primary impedence of 5,000 ohms and a secondary impedence of 4/8/16 ohms.

Electronic Engineering, Galt, Ont.

Pulse transformers 78

This series of PM pulse transformers is applicable as blocking oscillators, in triggering, low-voltage and counting circuits, for dc isolation, pulse shaping and for use as wide-band input and output transformers. Featuring a core of grain oriented silicon steel, this transformer has a chamfered band .062 in. wide which keys it for automatic mounting by soldering into etched circuit boards.

PCA Electronics, Inc., Sepulveda, Calif.

Audio isolation transformer 79

An isolation transformer, eliminating ground loop feedback in stereophonic sound systems where either amplifiers or pre-amplifiers use a common ground, has been developed by Triad Transformer Corp. Providing 1:1 impedance ratio at 0 dbm from 20 to 20,000 cps, model A-210P is furnished with a standard plug and socket for installation at the input connection on either preamp.

R. C. Kahnert Sales Co. Ltd., Scarborough, Ont.

Transistor transformer 80

Five new miniature transistor transformers have been introduced by Microtran Co. Inc. They are available in open-frame construction with standard channel or plug-in tab mounting channel. Size is less than one half cu. in. with a weight of approximately 4/10 of an oz.

E. S. Gould Sales Co., Montreal.

High voltage transformer 81

This high-voltage transformer features corona-free operation and compact design. It is intended for research purposes and is rated at 200,000 peak volts at 10 milliamperes. Mylar and special epoxies have been employed for insulation.

Del Electronics Corp., Mount Vernon, N.Y.

Diffused base transistors 82

Germanium high-frequency diffused-base mesa transistors 2N1141, 2N1142 and 2N1143 feature alpha cut-off frequencies up to 750 mc and power dissipation of 750 mv. With minimum current gains of 12, 10 and 8 db at 100 mc, these new p-n-p devices operate at juncture temperatures up to 100 C with 750 mw of power dissipation at 25 C case temperature. They are encased in welded JETEC TO-5 packages. All units exceed the reliability specifications outlined in MIL-T-19500A.

Texas Instruments Inc., Ottawa.

Alloy junction transistor 83

General Transistor Corp. has a new high-speed, high-gain, silicon p-n-p alloy junction transistor in pilot production. It has been designed for good switching and gain characteristics, coupled with low saturation resistance. It will be packaged in a TO-9 case.

Desser E-E Ltd., Montreal.

Low noise diode 84

Noise temperature as low as 50 K with the diode cooled by liquid nitrogen, and 100 K with the diode at room temperature, have been obtained in a high-gain 3,000 mc parametric amplifier using newly developed Hughes type HPA-8200 and HPA-2810 diodes. The low noise performance of amplifiers using the new diode is in a range competitive in many applications with the solid state maser.

With the noise temperatures of 50 K and 100 K obtained at liquid nitrogen and room temperatures respectively, the 3,000-mc amplifier gives 30 db of amplification with 2 mc band width, or 10 db of amplification with 25 mc band width. The diodes have a nominal cut-off frequency of 70,000 mc at maximum back bias with a nominal zero bias capacitance of 2.5 uuf.

R-O-R Associates Ltd., Don Mills, Ont.

Corona regulator tubes 85

Victoreen Type GV3A-700L corona-type regulator tube, for operation at 700 volts and for currents of 0.001 micro-amperes or higher, provides voltage

Replacement for rectifiers 86

Rated at 16000 volts peak inverse and 500 ma, dc, the Sarkes Tarzian type S-5207 silicon rectifier will replace up to 5 type 6 x 4 rectifier tubes in parallel. Pin connections are identical so the units are directly interchangeable.

Five other silicon rectifiers (4 full wave and 1 half wave) have been designed to replace 27 types of rectifiers. Current ratings range from 250 to 750 ma, dc with peak inverse voltages from 1600 to 4500. Cases have been designed for direct replacement using octal bases.

A. T. R. Armstrong Ltd., Toronto.

Components—cont.

regulation for many applications requiring economy of current drain from the primary power source. Applications are in nuclear battery regulation, solar cell regulation, and regulation of transistorized power supplies.

Other models are available for operation in the range of 400 to 1,500 volts with correspondingly low current.

Radionics Ltd., Montreal; Arva, Vancouver.

Thyratron tube 87

New filament and grid design have allowed a 30% increase in peak anode current in a new series of thyratron tubes. The new type VTP 7386 is adaptable to any circuit employing a C6J, C6JA, 5685 or 5C21 tube. The peak anode current rating of the new tube, however, is 100 amps, compared with 77 amps of the older units.

Filaments are made from woven mesh allowing a heavy oxide cathode coating to be applied directly on the filament without danger of chipping. The control grid is conduction cooled by heavy nickel supports and molybdenum grid rods. Multiple gold plating minimizes electron emission from the grid.

Vacuum Tube Products Co., Oceanside, Calif.

Silicon switching transistors 88

Fairchild 2N1131 and 2N1132 p-n-p silicon transistors closely match types 2N696 and 2N697. Existence of these closely related devices of opposite polarity affords opportunities for circuit designs based on complementary symmetry. Typical rise time is 8×10^{-10} seconds. Dissipation ratings are two watts at 25 C and one watt at 100 C.

R. D. B. Sheppard, Ottawa.

Photo multiplier tubes 89

A series of eight Mullard photo multiplier tubes have been introduced for scintillation counting and industrial applications. They differ in diameter and sensitivity. Among the tubes available are the 52AVP for prospecting in the soil; the 50AVP and 53AVP for ground prospecting and laboratory research; and the 54AVP for prospecting from the air.

An average anode sensitivity of 500 amp/lumen is obtained with a supply voltage of 1,800 volts on most of these tubes The design of the photo cathode and the first dynode is such that total variation in transit time is smaller than 6×10^{-9} second.

Rogers Electronic Tube & Components, Toronto.

Double tetrode tube 90

Transmitting double tetrode tube type QQE 04/5 has been designed for mobile radio use up to the 960-mc band. It may be used as an rf power amplifier or tripler, or in other applications such as low-power TV link equipment up to 1,000 mc.

At a plate voltage of 250 it will provide five watts into the load. Total plate dissipation is 20 watts; filament voltage is 6.3 or 12.6; transconductance is 10,500; radiation cooled. It uses a frame-grid construction.

Rogers Electronic Tubes & Components, Toronto.

High power transistors 91

Two new silicon transistors, WX1015 and WX1016, for switching and amplifier applications each have a collector to emitter voltage range from 30 to 300 volts and are rated at two and five amps with switching capacity to one kw. High voltage and current ratings, together with low saturation resistance (two-amp units 0.7 ohms, five-amp unit 0.5 ohms) enable either to handle high switching power with minimum losses.

Hermetically sealed in welded stainless steel cases, they are designed for mounting on an external heat sink by a threaded stud.

Canadian Westinghouse Co. Ltd., Hamilton.

Cathode ray tubes 92

Sylvania Electric Products Inc. has introduced a 23-in. picture tube with a safety panel bonded to the face plate. Television receiver manufacturers will be able to use the 110-deg tube without a separate safety glass.

Nine multi-purpose cathode ray tubes have also been announced. Type 3RP1A is a flat-face oscilloscope tube with electrostatic focus and deflection. Type 5WP11 is an oscilloscope tube for visual or photographic observation. It has magnetic deflection and electrostatic focus. Types 5AHP, 5AHP14A, 5AHP19 and 5AHP19A are round-glass-type high-resolution tubes which use electrostatic focussing and magnetic deflection.

Type 5ZP15 is a flat-face high-resolution tube with electrostatic focussing and magnetic deflection designed for use as a flying spot scanner. Type 5ZP24, designed for color flying spot scanning has electrostatic focussing and magnetic deflection. Type 7MP14 is a clear-face, round-glass, non-ion trap radar indicator tube with magnetic focus and deflection.

Hackbusch Electronics Ltd., Toronto.

Audio tubes 93

A group of five receiving tubes designed to minimize noise and hum in audio applications has been introduced by Sylvania Electric Products Inc. Type 6BQ5, a beam-power audio pentode, delivers 5.6 watts at 9.2% distortion single ended under 4.3 volt signal output. In push-pull at 250 volt plate and screen, it delivers 10.65 watts at 3.4% distortion; at 300 volts plate and screen 16.5 watts at 4.16% distortion.

Type 12AX7, an improved high-mu twin triode serves both as audio amplifier and phase inverter. It has separate cathodes and centre-tapped heater for operation at 12.6 or 6.3 volts.

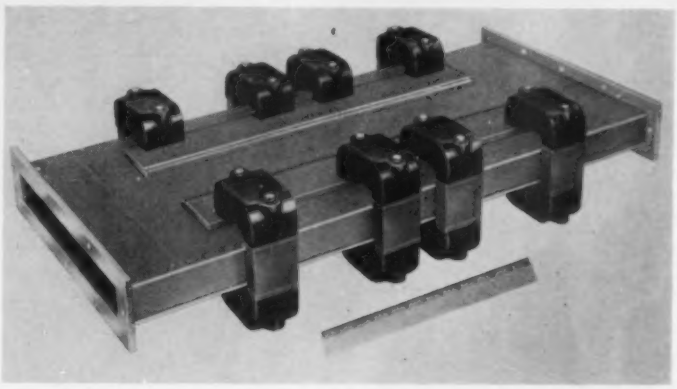
Type 7025 is a double triode designed to meet extreme limits of hum and noise. It has an equivalent noise and hum voltage of 1.8 microvolts rms average and

Ferrite isolator 94

Ferrite isolator model IUH1 has been designed to operate in the 500-700 mc region. It is constructed of special reduced height waveguide to minimize size and weight. It is 6¾ in. high, 19 in. wide, 30 in. long and weighs 100 lb. less transition.

Minimum transmit/receive isolation is 9 db; maximum insertion loss is 1 db. Average power handling capacity is 10 kw without cooling; peak power is 10 mw.

Raytheon Canada Ltd., Waterloo, Ont.



7 microvolts rms maximum.

Type 7199 is a nine-pin miniature mu triode and sharp cut-off pentode. The triode is normally used as a phase inverter, while the pentode is used as a high-gain audio amplifier. Type 6CA4 is a double anode, indirectly heated, common cathode rectifier. It delivers 150 ma maximum dc current.

Hackbusch Electronics Ltd., Toronto.

Cold cathode vacuum tube 95

This cold cathode tube operates on a new principle discovered by scientists of the U. S. Army Signal Research and Development Laboratory, Fort Monmouth, and further developed by Tung-Sol Electric Inc.

In the new tube the hot cathode is replaced by a cold cathode — a nickel cylinder coated with porous magnesium oxide. Instead of heat, a high voltage field, about 300 volts minimum, causes the electron flow.

When voltage is first applied to a tube containing this cathode the surface is not positively charged, and emission does not take place. It is necessary by some means to charge the surface to this operating voltage. Several methods have been developed that will do this in a fraction of a second to start the emission.

Many applications for tubes of this type are foreseen. They require less cathode power than hot cathode tubes, start faster, last much longer and are free from heater problems. They are about equal in cost, noise level and other characteristics with the comparable hot cathode tubes.

Alpha Aracon Radio Co. Ltd., Toronto.

Traveling wave tube 96

Permanent magnet focused K-band traveling wave tube type HA-49 has a frequency range of 10 to 16.0 kmc. Small signal gain is 30 db minimum; power output is 10 mw, minimum. The tube will provide 20 db or more small signal gain over the frequency band 10.0 to 18.0 kmc. The tube is suitable for use in airborne or other applications where space and weight is a premium. Focusing is accomplished by a periodic array of permanent magnets.

Radionics, Ltd., Montreal.

Four cavity klystron 97

The newly developed VA802 air cooled, four cavity klystron is rated at 1 kw cw. It can be tuned continuously from 1,700 to 2,400 mc and is focused with a permanent magnet. Frequency range of each tube is 1,700 to 2,400 mc; power gain is 40 to 50 db; power output into flat line is 1,000 watts; rf drive power, for maximum efficient tuning, is 0.1 watts maximum; typical efficiency is 40%.

VA-802 has been designed specifically for application in forward scatter communication systems and is suitable for both fixed station and transportable service.

Varian Associates of Canada Ltd., Georgetown, Ont.

Backward wave oscillator 98

Huggins Laboratories Ltd. L-band backward wave oscillator type HO-9 has a frequency range of 1.0 to 2.0 kmc. Power output is 10 mw (minimum); Helix voltage is 200 to 2,600 volts. Tuning is accomplished by varying the Helix voltage. Application is in microwave instrumentation and testing, as a swept local oscillator in superheterodyne receivers, and as a master oscillator in variable frequency transmitters.

Radionics, Ltd., Montreal.

Permanent magnet material 99

Indox VI is a highly oriented ceramic permanent magnet material for use where greater resistance to demagnetizing fields is required or where magnet length is limited as compared to its area. One proposed application is in microwave traveling wave tubes. Barium-iron oxide is oriented in the direction of pressing to produce this magnet material. Typical properties include a corrosive force of 2,550 oersteds, a residual reduction of 3,200 gauss, and a peak energy product of 2.4×10^6.

The Indiana Steel Products Co. of Canada Ltd., Kitchener, Ont.

Audio signal transistor 100

The series 2N1008, A, B, transistors covering a range of applications from hi-fi sets to guided missiles is being produced by Bendix Aviation Corp. They are suitable for use as single ended audio drivers and can dissipate 400 mw at 25 C and 67 mw at 75 C. Maximum collector base voltage is 60 volts.

Computing Devices of Canada Ltd., Ottawa.

Variable transformers 101

A new Variac family, the type W10, feature improved heat transfer and insulation, the substitution of wrought metal for castings to improve mechanical properties, and disc radiators to protect the brush track. They are available in portable and permanent versions in a variety of voltage and current ratings.

General Radio Co., Toronto.

Tube shield liner 102

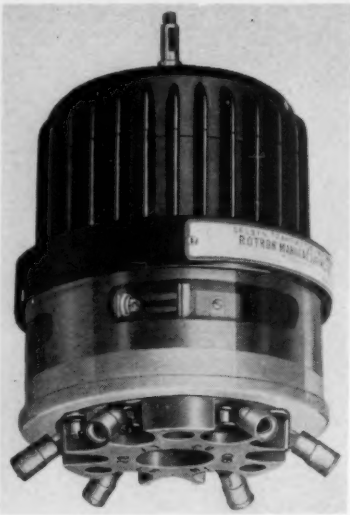
International Electronic Research Corp., Therma-flex is a beryllium copper liner for heat dissipating electron tube shields. The liners are available in shields for all standard sized miniature tubes as well as some of the larger tubes such as the 6094.

R.O.R. Associates Ltd., Don Mills, Ont.

High temperature connector 103

The new HR (heat resistant) connector, is designed to perform continuously in 1,000 F heat and under nuclear radiation bombardment. Moisture proofing on these connectors is accomplished by means of ball-cone seats on all mating surfaces. The series embraces a complete range of MS-type shell styles and sizes, and a wide variety of insert patterns. Layouts provide from 2 to 24 contacts in a single shell. HR connectors will mate with standard MS types.

Cannon Electric Canada Ltd., Toronto.



Industrial selsyn 104

This selsyn transmitter-receiver has been designed by Rotron Controls Corp. for industrial applications requiring sturdy equipment of moderate rotational accuracy. Stator and rotor windings are completely encapsulated and a glass-like finish of both air gap surfaces allow continuous immersion in water without loss of insulating quality.

Hoover Co. Ltd., Hamilton.

Components—cont.

Connectors for the laboratory 105

A number of new patch cords, shielded plugs, adaptors and insulators have been introduced to extend the range of connectors available for laboratory instrument use. A number of these are designed for shielded connection between ¾ in. spaced binding posts. Emphasis has been placed upon shielding properties of the connectors.

General Radio Co., Toronto.

Crystal oven 106

Features of the new Robertshaw-Fulton precision crystal oven are low power consumption, no noise generation, constant lead capacity, long-term stability, and cavity temperature variation less than 0.01 C average per degree ambient temperature change.

Keith Mercer Co. Ltd., Montreal.

Terminal lugs 107

A number of new terminal lugs, screws and other specialty hardware for the electronics industry have been introduced by Sido. Terminals carry CAMESA approval and can be supplied either silver plated to a thickness of 0.00003 in., or silver plated with gold flash.

Sido Ltd., Granby, Que.

Connectors and jacks 108

A number of Switchcraft connectors and Tini-Jax have recently been announced. Molded cabled assemblies with straight and right angle Tini-Plugs have pear-shaped one-piece tip rod that continues from the tip into the assembly, directly to the soldered connection of the cable conductor. A cable clamp connects the cable shield (or second conductor) to the plug sleeve. The RA-700 series are right angled, while the ST-700 series are straight.

The new shielded extension Jax with smaller outside diameter for attachment to cable have built-in cable clamps that serve dual purpose as a cable support and as a sleeve terminal. They are completely shielded, have solder lug terminals and are available in 2 and 3 conductor types for ¼ in. diameter sleeve plugs.

Another shielded extension Jax is a molded cable assembly with phone extension Jax. They are available in standard quarter inch inside diameter sleeve type, in 2 and 3 conductor designs.

Atlas Radio Corp. Ltd., Toronto.

Coaxial connector transitions 109

Series TR transitions are designed for laboratory or system applications wherever transitions from different types of coaxial connectors are required without loss of measuring accuracy. They feature low vswr, which is less than 1.05 over a frequency range up to 1,000 mc. They are available in either male or female connector arrangements from type N to BNC or TNC connectors. Other types can be supplied.

Tele-Radio Systems Ltd., Toronto.

Standard dial assemblies 110

These Beckman concentric and single dial assemblies are available from stock. Assembly BP-302-36 has a shaft diameter of ¼ in., 360 deg. outer dial; and an inner/outer dial ratio of 36:1. Model BP-302-100 has a ⅛ in. shaft, dial ratio of 100:1 and reads to 2 minutes of shaft rotation. A plastic index marker may be set at 0 deg., 90 deg. or 270 deg.

Assembly BP-532 is a single, low mass-and-inertia dial 3 in. in diameter, for ¼ in. shaft. It is available with 100 or 300 engraved divisions or may be ordered with other markings. Index block BP428 is an anodized aluminum marker for indexing of BP-532 dials.

R-O-R Associates, Ltd., Don Mills, Ont.

Plugs and standoffs 111

Seven and nine pin plugs (models P7 and P9) are nylon filled phenolic with silver-plated brass pins, enclosed by a silver-plated brass shroud. They make a convenient cable connector for fastening to standard 7 and 9 pin chassis sockets.

Hot tinned phosphor bronze conductors are molded into polytetrafluoroethylene insulation to form these feed throughs and standoffs. They may be force fitted into one-eighth-inch chassis holes or held with a nut which will cut its own thread. Voltage rating is 8,000.

R. Mack & Co. Ltd., Vancouver.

Heat dissipating tube shields 112

Siemens Ediswan 7 and 9 pin heat dissipating tube holders consist of sockets and shields. The outer shield, besides functioning as an efficient rf screen, has high convection transfer by virtue of the large surface area.

R. Mack & Co. Ltd., Vancouver.

Coaxial rotary joint 113

Model 15-001 coaxial rotary joint was originally designed for use with a 60-ft telemetry tracking antenna system. The assembly is weatherproofed for outside mounting and may be used for ⅞ inch styroflex coaxial cable or equivalent. A seal permits pressurization from either end. Case materials are of brass, and a beryllium copper wraparound spring with finger contacts to assure connection between outside conductors. Impedance is 50 ohms; frequency range is 216-246 mc; vswr 1.1 or less; insertion loss at 225 mc is 0.1 db; temperature range is —20 to +75 C. Dielectric is Teflon.

Radionics, Ltd., Montreal.

Barrier strips 114

These series 500 barrier strips have been granted CSA approvals for ratings up to 30 amperes and 1,200 volts. Higher ratings are permitted in certain types of equipment. These strips are available in a variety of molded compounds and in all lengths up to 31 contacts.

United-Carr Fastener Co. of Canada Ltd., Hamilton.

Fixed pad attenuator 115

Applied Research Inc. is supplying a family of fixed pad coaxial attenuators and a termination for applications using type N connectors. The attenuators are designed as type HFA/N-50 and have a nominal impedance of 52.5 ohms. They are usable in a frequency range from dc to 2,500 mc; maximum vswr through this range is 1.2. Average power rating is ½ watt. They are available in stand-

ard models for attenuation values of 1, 2, 3, 4, 6, 10, 12, 15, and 20 db.

The coaxial termination for type N connector application is designated type HFT/N-50. It has an impedance of 52.5 ohms and maximum vswr of 1.2 from dc to 2,500 mc.

Electroline Television Equipment Inc., Montreal.

Coaxial connectors 116

Two wide band coaxial connectors in the 5,000 to 11,000 mc range have vswr of 1.25 or better. Each connector can be individually calibrated at every 100 mc point over the entire range if requested.

Designated models KA-11-06 and KA-51-05, these coaxial connectors can be supplied for either specific or broad band use.

King's Electronics (Canada) Ltd., Montreal.

Power coaxial attenuator 117

Maury & Associates nonresistive fixed power attenuator model AF-1000C is designed for broad band applications. It is calibrated from 100 to 1,000 mc, attenuation range is 3 db at 100 mc and 35 db at 1,000 mc; attenuation factor is 10:1, vswr is 1.2; power handling capacity is 50 watts cw; operating temperature is from 40 C to 100 C and temperature co-efficient is 1.05 db per degree centigrade.

The unit is supplied with type N connectors or can be supplied with other connectors on request. A shorted termination is supplied for matched load applications from 300 mc to 1,000 mc with less than 1.25 vswr.

Tele-Radio Systems Ltd., Toronto.

Aluminum coaxial rf plugs 118

Utilizing aluminum shells, the new ALN and ALSC connectors are 35% to 40% lighter in weight than comparable standard rf coaxials. The "AL" series accepts RG, Foamflex and Raytherm coaxial cables. The ALSC accommodates only RG cable.

Cannon Electric Canada Ltd., Toronto.

For more information on New Product and Catalogue items, use Reader Service Cards on pages 69 and 70

Coaxial ferrite isolators 119

Ferrite strips are inserted directly in the coaxial line of the new series of Cascade Uniline load isolators, eliminating bulky transitions to and from waveguide. The CN121 series all measure 6⅝ in. long, with a maximum diameter of 1½ in. They are intended for use in low and medium power coaxial systems and normally are supplied with female type N connectors on both input and output.

Performance characteristics of the four isolators are as follows: CN121 operates from 4.0 to 7.0 kmc, providing 10 db isolation; CN121A operates from 5.0 to 7.0 kmc providing 20 db isolation; CN123 operates from 2.7 to 2.9 kmc, providing 20 db isolation; CN124 operates from 2.5 to 3.8 kmc providing 10 db isolation. Insertion loss is 1.0 db.

Microwave Systems, Scarborough, Ont.

Stereo ribbon microphone 120

The Lustraphone stereo-ribbon microphone unit consists of two identical ribbon velocity microphones mounted vertically in line. The upper microphone can be rotated to an angle of approximately 100 deg. from the in-line position, thus enabling the optimum setting for any contingency of stereophonic transmission. Relative positioning of the microphone units gives a variety of directional effects. With both units in-line, they can be used together as a single noise-eliminating microphone.

Frequency response is substantially flat between 50 and 13,000 cps; output impedance of each unit is 20 ohms; sensitivity is 90 db below 1 volt/dyne/cm² at 20 ohms.

D & B Sound & Signals Inc., Montreal.

Telephone line protector 121

Budelman type 167X1 protector uses a gas-filled glass tube surge voltage arrestor to protect 2-wire communications lines and other electronic equipment. It is mounted in an aluminum housing for use either indoors or outdoors.

Breakdown voltage is 300. The protector will carry 50 amperes for 2 seconds or 7 amperes for 10 minutes after breakdown. Gaps are permanently fixed and are enclosed in a constant atmosphere to ensure uniformity of breakdown voltage and high speed (about ½ microsecond).

Tele-Radio Systems Ltd., Toronto.

Instruments

Transfer function analyzer 122

The Muirhead transfer function analyser can be used to carry out frequency response tests of automatic control systems. The equipment comprises: model D-880-A two-phase, low-frequency decade oscillator for exciting the system sinusoidally; model D-729-B low-frequency phase-meter for measuring phase and amplitude differences between two signals; model D-925-A tunable filter for use with the phasemeter when output signals from the system under test are distorted.

The combined equipment has a frequency range of 0.5 cps to 10 kc and can deal with phase differences from 0 deg to 360 deg, amplitude differences up to 70 db, and harmonic distortion up to 100%.

Muirhead Instruments Limited, Stratford, Ont.

Instruments—cont.

Differential voltmeter 123

The John Fluke Mfg. Co. model 803 is 3 instruments in one: a differential ac voltmeter, a dc potentiometer and a vtvm when used in the search range positions. Accuracy is better than 0.05% on dc and 0.2% on ac from 0.1 volt to 500 volts. The frequency response of the ac converter section is from 30 cps to 5 kc. Other features are: direct in-line digital read-out, automatic punctuated decimal points, standard cell reference, and chopper-stabilized null detector.

The Glendon Co., Ltd., Toronto.

Micro-micro ammeter 124

Millivac model MV-11D micro-micro ammeter has a full scale accuracy of 2% and is capable of dc current measurements from 10 uua to 10 amperes. All ranges are left zero. The instrument has 23 ranges: 100 uua full scale through 10 amperes. A total of 23 separate calibration controls permit adjustment of all ranges. An amplifier output provides 2.5 volts at 0.5 ma for full scale deflection on any range.

Instronics Ltd., Stittsville, Ont.; Radionics Ltd., Montreal.

AC differential voltmeter 125

Millivac MV-212C ac differential vtvm is designed for differential measurements from 0.7 millivolts to 300 volts. Frequency range is 20 cps to 500 kc. Dual range attenuators are provided. They may be balanced by a common mode rejection control for ratios up to 100:1. The accuracy of the instrument is 3%.

Conversion to a single input ac voltmeter is accomplished by shorting one input terminal. An amplifier output permits simultaneous output and monitoring by an oscilloscope. Input impedance for each unit is 500,000 ohms shunted by 20 uuf.

Instronics Ltd., Stittsville, Ont.; Radionics, Ltd., Montreal.

Kit modernizes meters 126

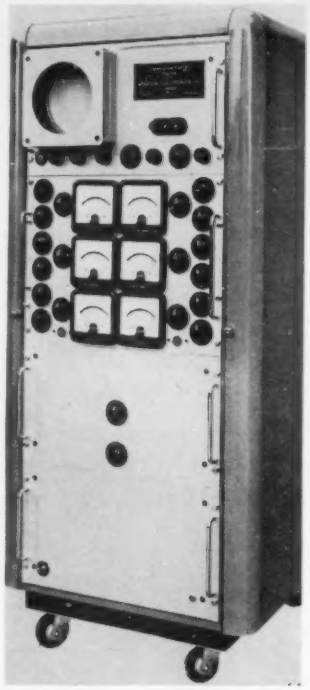
For many years Millivac has equipped its sensitive dc vacuum tube voltmeters with a 120 cps tuned chopper. A new chopper conversion kit contains a 60 cps chopper which is untuned. With desirable low contact noise characteristics and a life expectancy of 10,000 hours, the conversion kit can be used to modernize old Millivac meters.

Instronics Ltd., Stittsville, Ont.; Radionics, Ltd., Montreal.

Multistylus recorder 127

Radicorder model 3-100A uses fixed styli techniques to record multiple channels of pulse information or as many as 646 on-off functions. It plots analog or digital data in decimal-digital, binary-digital, or discrete-level analog form on electrosensitive paper chart. Other features include quick-look editing, separate or overlapping traces, logarithmic data presentation, flexible timescale presentation, and variable grid lines.

Radionics, Ltd., Montreal.



Transistor tester 128

The Winston Electronics Ltd. transistor curve tracer type 1006 can test both p-n-p and n-p-n types. Saw tooth or step voltages up to a maximum of 150 vac (negative for the collector and positive for the emitter) are available. Continuously variable dc voltages up to 150 are also available for testing. The equipment has been designed to test low-power transistors.

Mechron Engineering Products Ltd., Ottawa.

Chart recorder 129

The Rustrak strip chart recorder measures only 3⅝ in. x 5⅝ in. x 4⅛ in. It contains a 63-ft roll of dry marking pressure sensitive chart paper which is sufficient for 31 days recording at 1 in. per hour. In operation the galvanometer pointer swings freely for maximum accuracy, being clamped for marking briefly once every two seconds. Gear trains are available for different chart speeds. Standard scale is 0-1 milliampere at rated accuracy of 2% of full scale. Drive motor power is 115 volts, 60 cps.

Elder Electronics, Burlington, Ont.

Portable oscilloscope 130

Designed for general laboratory use and service work, the Telequipment Serviscope combines many desirable features. The high gain dc coupled amplifier has a total of 8 stages including interstage and output cathode followers. The calibrated input attenuator gives direct reading of ac or dc input voltages from 100 mv/cm to 50 v/cm over a frequency range of dc to 6 mc. The wide range calibrated time base has 18 preset sweep speeds from 1 usec/cm to ½ sec/cm.

There are two modes of triggering: automatic synchronization in which the time base locks automatically to any frequency between a few cycles and 1 mc; selective triggering enables the time base to be triggered from any selected point on the input waveform. A built-in tv synchronization separator selects line or frame pulses from positive or negative video signals.

Canadian Electronics Ltd., Edmonton.

Temperature indicator 131

This temperature indicator and controller is self-contained with built-in 25-50 contactor and plug-in thermocouple. Power may be obtained from any 110 or 220 volt outlet. Temperature calibration is between —200 and +5,500 F.

The instrument can be connected with heating and refrigeration equipment to maintain accurate temperature control.

Thermovolt Instruments Ltd., Toronto.

Tritium monitor 132

The Atomic Accessories model TSM-91 monitor is designed to measure continuously radioactive gas contamination in air. It is also capable of checking the presence of alpha or low energy beta emitting isotopes in solid or liquid form by use of a "sniffer" hose which couples to the air intake port of the instrument.

Four instrument ranges are included, corresponding to 10^2, 10^3, 10^4, 10^5 microcuries per cubic meter air of tritium. Ion chamber capacity is 660 c.c. Power requirement is 110 volts, 60 cps.

Radionics, Ltd., Montreal.

Automatic sample changer 133

The Baird-Atomic automatic sample changer provides flexibility in programmed and automatic countings of radioactive samples. Up to 50 samples, held in a magazine, can be programmed and counted with no attention required after the magazine is loaded. This reduces the time required in radioassay work.

Radionics, Ltd., Montreal.

Chromatogram scanner 134

The Atomic Accessories Radio Chromatogram has been designed for counting carbon 14, sulphur 35 and tritium. It is mounted on a drum and placed in the scanner housing. The drum rotates in front of the collimated detector. The detector is connected to a precision count

rate meter whose output drives a rectilinear recorder.

Radio chromatograms up to 56 cm can be placed on the drum. Maximum width of paper strip is 3.5 cm. Activity range is 5.2 x 10^{-4} microcuries of tritium; scale is 0-200 cpm; peak count is 36 cpm; speed of scanner is 3 in. per hour.

Radionics, Ltd., Montreal.

Glow tube scaler 135

This glow tube scaler for Geiger counting, Baird-Atomic model 123, has an all-Dekatron glow tube five digit capacity with no mechanical register required. Capacity is 99,999 counts; resolving time is 150 usec; input sensitivity is —¼ volt; high voltage supply range is + 500 to + 2,500 volts, variable.

Radionics, Ltd., Montreal.

Portable test instruments 136

Three Nash & Thompson test instruments have been introduced by their Canadian representative. Sensitive Valve Voltmeter has voltage ranges of 0-30, 100, 300 millivolts and 0-1, 3, 10, 30, 100, 300 volts. Power ranges are —40 to —18; —30 to —8; —20 to +2; —10 to +12; 0 to +22; +10 to +32; +20 to +42; +30 to + 52 dbm. Accuracy is rated at ±1% from 100 cps to 100 kc; ±5% from 50 cps to 250 kc; ±10% from 40 cps to 500 kc.

DC Valve Voltmeter & Microammeter operates over the voltage ranges of 0-1, 3, 10, 30, 100, 300, 1,000 volts. Current ranges are 0-0.1, 0.3, 1, 3, 10, 30, 100 microamps. Accuracy is rated at ±3% on all current ranges and all voltage ranges except 0-300, 1-1,000 volts where it decreases to ±4% full scale.

AC-DC Valve Voltmeter measures ac voltages in the ranges 0-1, 3, 10, 30, 100, 300 volts. It measures dc voltages in ranges 0-1, 3, 10, 30, 100, 300, 1,000 volts with centre zero facility on all ranges. Frequency response on ac is flat over the range of 500 cps to 50 mc; ±0.3 db from 100 cps to 100 mc; ±0.7 db from 50 cps to 200 mc or above.

Emile Tasso Agencies, Montreal.

Non-destructive testers 137

This group of instruments has been designed by Les Laboratories de Physique Appliquee for the non-destructive inspection of metal. Eddy currents are utilized to test non-ferrous metals, while magnetic properties are used in the testing of ferromagnetic metals. Structograph is an instrument designed to detect flaws in metal bars, tubes and structural members within the diametric range of 0.5 mm to 300 mm. Structotube is a portable instrument designed to inspect and check corrosion effects in pipes and tubular components. Structocable, derived from the Structograph, has been designed to check continuous cable such as in mine hoists.

Ferro-test and Ferro-sigmatest are two instruments for checking and sorting steels. They operate from either the difference between magnetic characteristics or direct testing of permeability differences. The two instruments are complementary, operating in 2 sensitivity ranges.

Emile Tasso Agencies, Montreal.

Calibration facility 138

Radio Frequency Laboratories, Inc. model 10 test equipment cart supports the model 829 ac-dc instrument calibration standard and the model 150 variable frequency power supply to provide an easily transportable electrical instrument calibration facility.

Calibration of ac and dc meters to 0.5% accuracy can be accomplished over a wide range of current and voltage. For calibration of ac meters, output frequencies of 60 cps and 400 cps are available from regular 115v, 60 cps lines.

Instronics Ltd., Stittsville, Ont.

Decimal scaler 139

The Eldorado Electronics decimal scaler model SC-700 has been designed for general radiation counting applications. Input sensitivity is 25 millivolts; double pulse resolution is better than 1 microsecond. The instrument features seven decades of decimal count storage, a stable feed-back input amplifier, a precision integral discriminator, and a built-in test circuit. Provision is made for control of count-start and count-stop by a pre-set timer.

Radionics, Ltd., Montreal.

Pulse height analyzer 140

The PA-4100 multi-channel analyzer has been designed by Eldorado Electronics for use where high input pulse rate must be analyzed with low counting loss. Featuring a basic double pulse resolution of 1 microsecond, the instrument has an input rate of 50,000 counts per second. Each channel is capable of counting and storing uniformly spaced pulses at a rate of 2,500 counts per second (limited only by the mechanical register; in channel double pulse resolution is 10 microseconds).

Functionally, the analyzer is of the stacked-discriminator type utilizing a window or expander amplifier and differentially - biased discriminators to achieve differential pulse sorting. Threshold of the 20-volt input window may be varied continuously or in five preset steps. Thus, up to 100 spectrum points may be obtained from a 20-channel analyzer.

Radionics, Ltd., Montreal.

Current and voltage standard 141

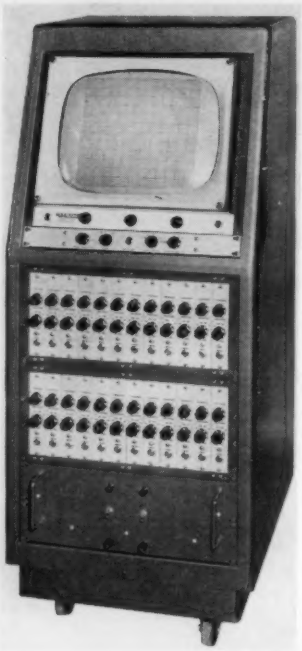
Current and voltage standard DC-2A has been designed for use in the calibration of dc measuring devices, precise input for calibration of computers or as the input of a constant in the solution of problems. It can be used as a signal input source for the calibration of telemetering systems and data recording devices, and has been used in checking phantastron and automatic frequency control circuit characteristics.

Radionics, Ltd., Montreal.

Inductance bridge 142

The Boonton Electronics Corp. model 63A inductance bridge measures inductance from 0.002 uh to 100 mh with an accuracy of the order of 0.25%. An internal oscillator with several frequencies between 1,000 cps and 100 kc is provided along with an internal detector and a null indicator. A switching arrangement allows the use of external oscillators and detectors. Series resistance can be measured in a range of 0.01 to 10,000 ohms.

Bayly Engrg. Ltd., Ajax.



Multi-channel oscilloscope 143

Rycom multi-channel oscilloscope RM24 can display up to 24 channels of information simultaneously on a 17 in. long-persistence screen. Frequency response is dc to 3500 cps; up to 20 kc under certain conditions. Input is of the differential type, dc coupled.

A 12-channel model is also available. In both models up to half the plug-in channel amplifiers can be replaced with ECG preamplifiers when 500 microvolts per inch sensitivity is desired. In this case the maximum number of channels on the console model is reduced to 12, and on the table model to 6.

Tele-Radio Systems Ltd., Toronto.

Instruments—cont.

Pressure standard 144

The BJ Electronics Vibromanometer is a portable electronic secondary-pressure standard employing direct conversion of input pressures to a digital fm signal. It has been designed for rapid accurate line and process-stream pressure checks. Read-out, visual or printed, is adjustable for any desired measurement unit, such as psi, percent of full scale, millibars, etc. The vibrating wire transducer accepts pressure inputs ranging from 0 to 10,000 psi and converts these analog pressures directly to digital-frequency output.

Instronics Ltd., Stittsville, Ont.

Universal ratiometer 145

Model B811A universal ratiometer is a product of FXR, Inc. By the use of printed wire circuitry this instrument houses, in one package, a vswr amplifier and a ratiometer for reflectometer measurements. For convenience vswr, db and reflection coefficient scales are provided. Bolometer or crystal operation may be used. A two-cycle logarithmic meter on the front panel permits vswr reflectometer readings from 1.02 to infinity, on two ranges.

Radionics Ltd., Montreal.

Sequential tester 146

Model E-7740 automatic heater test set was originally designed for high-speed automatic testing of electric stove elements. It may, however, be applied to other types of electrical and electronic devices. In operation, a jig makes simultaneous contact to desired test points to check such things as dielectric strength, element resistance and leakage to the sheath. The test sequence is carried out automatically and indicator lamps provide a go, no go signal. Meters on the instrument are used during initial set-up.

Canadian Research Institute, Toronto.

Signal sources 147

FXR, Inc. signal generators models C772A and X772A are power sources which supply frequency ranges from 3,950 to 11,000 mc. Model C772A has a frequency range from 3,950 to 8,200 mc. Model X772A has a frequency range from 7,000 to 11,000 mc. Power output of both models is variable from 10 to 100 mw. The instruments supply an internal pulse or square wave modulation and provision is made for the injection of an external pulse or frequency modulation.

Radionics, Ltd., Montreal.

Multi tester 148

Pressure, load, force displacement and strain can all be measured directly with the Telechrome Poly-Gauge model 1650, simply by plugging in the appropriate transducer or strain gauge. The range factors of 100, 25, 10, 2.5, 1.0 or 0.25 are selected by the range control. An output which can be used for recording or control is also provided. The instrument, which is self contained and powered by 117 vac, weighs 22 lb. and measures 15 in. x 9 in. x 6 in.

Conway Electronic Enterprises Reg'd, Toronto.

Frequency sensor 149

Frequency sensor C400FSI employs magnetic and static elements throughout and operates on the go, no-go principle. Read-out is achieved by means of green and red lamps, denoting "within tolerance" or "out of tolerance." Accuracy is ¼% or better.

The sensor operates at 115 volts, and has a nominal frequency made to customers' specifications. Temperature limits are —65 F to +185 F; vibration specifications are 20 g over the range of 2 cps to 2,000 cps.

Magnetic Circuit Elements Inc., Montrose, Calif.

Signal generator 150

Continuously variable over a frequency range from 2 to 200,000 cps, Southwest Industrial Electronics Co. model N-1 signal generator is transistorized and battery operated. It provides an output of one volt rms at less than 1% distortion. It has a calibrated attenuator.

Electrodesign, Montreal.

Time delay generator 151

The type 1392-A time-delay generator contains two independent time delay circuits. They can be operated as parallel circuits, cascaded circuits or the second circuit can be operated as a coincidence "and" circuit enabling-gate started by the first delay. The input signal may be sinewave 0.1 volt rms; square wave 0.3 volt peak-to-peak; pulse 1 volt peak. Input frequency range is dc to over 300 kc.

Delay number 1 has a range of 0-1.1 seconds in seven ranges. Accuracy on the 0-1 usec range is ±0.01 usec; 1 usec-1.1 second range is ±1% of dial reading. Delay number 2 has a range of 0.5 usec to 0.5 sec in six decade ranges. Accuracy is ±3% of dial reading.

General Radio Co., Toronto.

Sound level meter 152

Noise measurement is the primary function of sound level meter type 1551-B. However, with its many accessories it is capable of accurate sound-pressure measurements, sound-spectrum analysis, and other accoustic measurements. Sound level range is from 24 db to 150 db (re 0.0002 microbar). Any one of four response characteristics can be selected by a panel switch. The meter covers a span of 16 db with calibration from —6 to 10 db. The attenuator is calibrated in 10 db steps in 30 to 140 db above the standard reference level.

General Radio Co., Toronto.

For more information on New Product and Catalogue items, use Reader Service Cards on pages 69 and 70

Equipment

Telemetering dual mixer-monitor 153

The mixer-monitor model 7-100 is a modular device used to combine a maximum of four data sources into a composite input signal for recording on a signal track on a magnetic tape recorder. Input frequencies from 300 cps to 100 kc may be accommodated. A panel meter provides for visually monitoring the levels of any individual signal or the composite. In addition, other tape recorder functions including the playback output level, the record-head bias current and the record-head signal current, may be selectively monitored.

Radionics, Ltd., Montreal.

Telegraph terminal 154

The Radio Frequency Laboratories model 1220 transistorized telegraph terminal has been designed for transmission systems in which reliability is the dominant requirement. Standard or special frequency shift channels are available from 420 cps beyond 3,300 cps, for signaling and 60 to 250 words per minute teleprinter operation. The chassis mounts one or two modular plug-in transmitters or receivers with filters and power supply, loop current controls, loop and line monitor jacks, and fits the standard 19-in. relay rack.

Line impedance (carrier) of 600 ohms permits operation on open wire, cable, radio, or microwave links. The equipment can operate directly on a 12 or 24 vdc station battery or rectifier, or with its own power supply from the 115-volt, 50/60-cps power line.

Microwave Systems, Scarborough, Ontario.

Transmitter receiver 155

The GR-310 equipment provides telefony and CW telegraphy communication facilities in the frequency range of 2.5 to 8 mc at a power output of 1 watt. Four switched channels are available and can be spaced anywhere within the frequency range.

This transistorized transmitter/receiver is fully portable and uses rechargeable silver-zinc batteries or standard dry batteries. It weighs 14 lb. complete with batteries, whip antenna, handset and carrying case.

Redifon Canada, Montreal.

Two-way radio 156

A range of 450 mc, fm mobile radio equipment has been introduced by Kaar Engineering Corp. For mounting under a car instrument panel the radio comes in a self-contained unit. For a trunk mounting there is a remote control head. Both types can be supplied with 12 vdc transistorized power supply, 6-volt vibrator supply, or a combination 12 vdc/115 vac supply.

Transmitter power output is 4-5 watts, and receiver sensitivity is better than 1 microvolt for 20 db quieting.

Tele-Radio Systems Ltd., Toronto, and Armstrong-Pacific Ltd., Vancouver.

Staff location system 157

This staff paging system consists of a small transmitter control unit and a number of transistorized receivers that clip on the pocket or dress of personnel. When the operator at the control unit presses a button, a magnetic field is established within a loop of wire surrounding the building. A coded signal is picked up by the selected receiver only. If there is a message to be passed on, the operator can speak directly to the person concerned. The system is CSA approved and does not require a license from the Department of Transport.

Multitone of Canada Ltd., Toronto.

Telegraph equipment 158

By transistorized circuitry and concomitant compact design, 18 channels of FS tone telegraph keying equipment have been designed to occupy panel space only 19 in. wide x 5¼ in. high x 18 in. deep. Eighteen channels of FS tone telegraph converter equipment have been made to occupy panel space only 19 in. wide x 10½ in. high x 18 in. deep.

Northern Radio Mfg. Co. Ltd., Ottawa.

Personal transceiver 159

Designed specifically for airport ramp use, Tiny-Talky is a 450 mc, fm transmitter/receiver. Weighing only 5½ lb., the unit is supplied with a belt harness which supports the unit at the waist. A ground-plane antenna is worn on one shoulder, and a lightweight earphone permits continuous monitoring. It is recommended that it be used with a base station having at least 5 watts power output.

Tele-Radio Systems Ltd., Toronto.

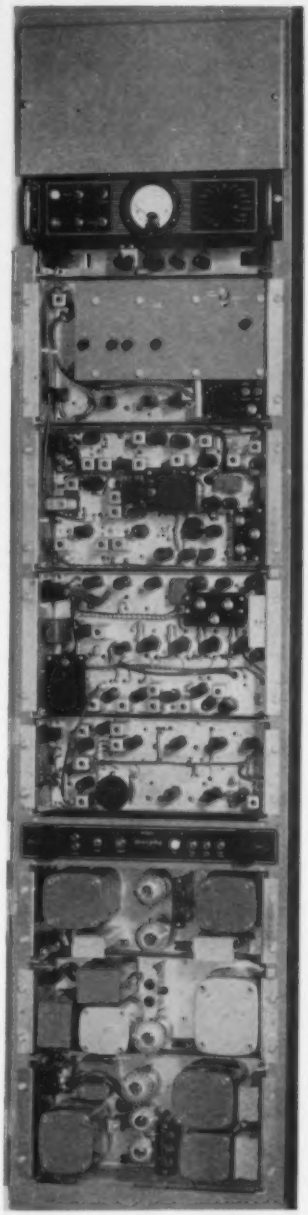
Control and alarm system 160

Sequential scanning techniques are used in this equipment to carry a large number of control and alarm channels over a narrow-band communications circuit. Developed by Moore Associates Inc., it is arranged in a series of fully transistorized modules. No moving parts are used. Connections to external equipment under control are by means of transistorized relays.

Tele-Radio Systems Ltd., Toronto.

Telemetry multi-coupler 161

Model 1104 multi-coupler provides a means for connecting as many as nine telemetry receivers into a single antenna



Radio link 162

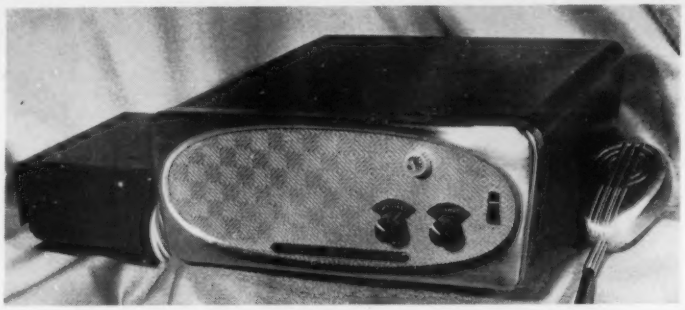
Murphy Radio Ltd. radio link terminal is capable of multiplexing up to 24 channels of ssb voice carrier on a 108 kc baseband. It operates at 132-174 mc. Either 15 or 60 watts output can be obtained and peak deviation is ±250 kc.

Tele - Radio Systems Ltd., Toronto.

Mobile radio 163

A new SY line of fm mobile radiotelephone equipment features compact design permitting underdash mounting of all mobile models. In the 30-watt mobile unit, the main unit measures 11 in. wide, 4 in. high and 12 in. deep. The power supply measures 6 in. x 6 in. x 3 in.

International Systcoms Ltd., Montreal.



Equipment—cont.

output. By cascading two couplers, 17 outputs are provided. Interchannel isolation is 55-85 db, frequency 216 to 255 mc, band width 30 mc, and gain is 2 db nominal.

Radionics, Ltd., Montreal.

Portable ac power supply 164

Toropak is a self-contained portable ac power supply capable of delivering 200 watts of power (115 volts, 60 cps ±1 cps) for up to four hours continuously without external connections. Fourteen volts dc is also available from the internal battery, which be recharged from any 115 vac line or from a car's cigarette lighter receptacle. Weight is 55 lb.

Tele-Radio Systems Ltd., Toronto.

Non-overloading linear amplifier 165

The Eldorado Electronics type LA-600 linear amplifier is a pulse amplifier for general nuclear research laboratory applications. Each major section of the instrument is packaged in a plug-in element. Lumped constant delay lines are used to achieve pulse shaping and since these delay elements are mounted on a plug-in module with the portion of the circuit with which the delay elements are associated, characteristics of the output pulse may be changed by changing a plug-in unit.

Model LA-600A is a basic amplifier having maximum voltage gain of 50,000, a gain stability of 1% for 10% change in line voltage, output pulse width of 1.2 usec, output pulse rise time of 0.2 usec, double pulse resolution of 2.4 usec. Model LA-600B is similar but includes an integral/differential pulse height selector. The basic double pulse resolving time is 1.0 usec including differential discriminator.

Radionics Ltd., Montreal.

Constant voltage dc power supplies 166

The Advance constant voltage dc power supplies utilize a constant voltage transformer followed by a semi-conductor rectifier and high capacitance filter. They are mounted on chassis which are suitable for 19-in. rack mounting if desired. The electrical circuit is insulated from ground, permitting operation at either polarity. Available in the series are power supplies with output ratings from 6 to 48 volts with current ratings as high as 4 amperes. Eight different stock units have been chosen to cover dc voltages used in most transistor applications.

Conway Electronic Enterprises Reg'd., Toronto.

Special effects generator 167

The Telechrome model 490-A TV special effects generator is capable of producing 72 different preset dissolves and a large number of special effects which may be keyed electronically. Thus, by use of TV cameras and photographs it is possible to produce background effects of a limitless variety. The generator will operate on both black and white, and color TV signals.

Conway Electronic Enterprises Reg'd., Toronto.

Data processing equipment 168

The Dymec model DY-2512 card punch coupler transfers staircase decimal data of the form produced by Hewlett-Packard and Dymec electronic counters to the ten-line input circuits of the IBM model 523 summary card punch. The coupler transfers up to 11 decimal places of counter information and supplies up to eight additional places of auxiliary numbers preselected on front panel controls or by external programming devices.

The model DY-2513 counter scanner operates from staircase voltages, transferring the information displayed on each counter to a single Hewlett-Packard model 560A digital recorder. It automatically records pre-set decimal information manually selected by six decimal dials on the front panel. In addition, it synchronizes the count and display functions of the counters and the printing function of the recorder.

Atlas Instrument Corp., Ltd., Toronto.

Pocket receiver and transmitter 169

Complete 2-way communications is available for the man on foot with the Handi-Talkie receiver and transmitter combination. The 46-ounce transmitter can be worn on the belt and provides a full 1¼-watt rf output in the 25-54 mc band, or 1.0 watt in the 144-174 mc band.

The receiver is transistorized and another model is being designed with selective calling facilities.

Canadian Motorola Electronics Ltd., Toronto.

Continuous gain amplifier 170

The Alleghany Instrument Co. model 512-A dc amplifier is chopper stabilized and features 11 fixed gain steps with continuously variable gain between these. It was designed to amplify signals from wire strain gauge transducers, thermocouples or other low level sources. The frequency response is dc to 10 kc, ±0.3 db, (down 3 db at 40 kc). Output is ±35 volts (resistance loads greater than 1,000 ohms), ±40 ma (resistance loads of 4 to 400 ohms).

Instronics Ltd., Stittsville, Ont.

Induction generator 171

The Radyne model C90 high frequency induction generator has a power rating of 10 kw and operates at a nominal frequency of 450 kc. The equipment, weighing 700 lb. and measuring 3 ft. x 2 ft. x 5 ft., is available for use with 500/600 volt, 60 cps supply. The unit can be supplied with accessories, including worktable, double station rf switchover units, water re-circulators, and timers.

Dominion Electrohome Industries Ltd., Kitchener, Ont.

Telephone for the handicapped 172

The Rehabaphone makes telephoning possible for handicapped persons with little or no muscle power. It can be used by any one able to press, in any way, against the lever of a sensitive microswitch. The instrument replaces a standard telephone and plugs into a telephone extension jack. Power required is 110 volts ac. A number of special operating controls, microphones and speakers are available to suit the customer's requirements.

D & B Sound and Signals Inc., Montreal.

Portable program amplifier 173

Model L60 program amplifier has been designed for use in public address systems, industrial music background systems, school and hospital distribution systems, requiring continuous 24-hour operation.

Audio power output is 85 watts peak, 60 watts with less than 3% harmonic content, 45 watts with less than 1% harmonic content. Frequency response is 50 to 20,000 cps, ±1 db. Sensitivity for rated output of 60 watts is: 0.003 volts for microphone; 0.58 volts for phono; 0.11 volts for remote.

Electro-Vox Inc., Montreal.

Magnetic tape deck 174

The Tape-Athon model 375-7 and 375-10 tape decks will accommodate 7-in. and 10-in. reels respectively. They have an automatic switching arrangement so that any selected segment of any length from the tape can be played and repeated continuously until shut off.

The equipment consists of a deck only without amplifier or pre-amplifier. Tape speed is 3.75 ips resulting in a frequency response of 50 to 7,500 cps. Output of 0 db direct from the twin heads is 0.6 mv.

A wide selection of pre-recorded music is available on 7-in. (four hours) and 10-in. (eight hours) reels.

Industrial and Commercial Communications Ltd., Wallaceburg, Ont.

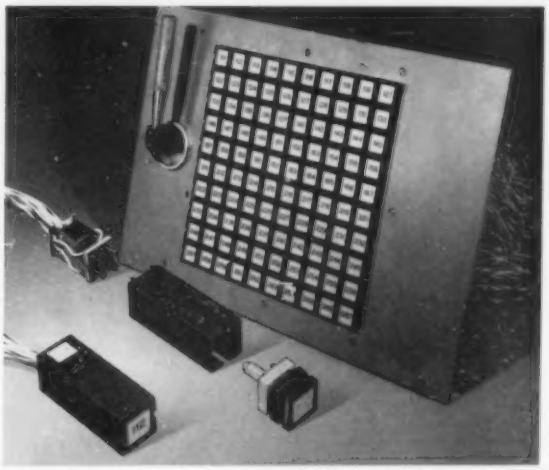
Dictation machine 176

The Canadian-designed Sonograph Mark V dictation machine is now on the market. The re-usable mylar magnetic belt will fit a No. 10 envelope for mailing. Features include: external speakers available for group listening, pre-determined volume control, printed circuits, built-in erasing head, convertability for use with car batteries.

Sonograph Ltd., Toronto.

Intercom-radio system 175

Designed for use in homes, this transistorized Talk-A-Phone Co. equipment combines a radio with intercom facilities. The central master station (available with or without radio) contains the transistor amplifier to operate the entire system. It operates from any 9-volt dry battery and requires only one battery for



Lighted pushbutton 177

A new group of lighted pushbutton switches, designated C-20, is suited to matrix applications. These are some of the features: double-lighted with No. 327 bulbs; square modular construction mounts in ⅞-in. hole; requires no barriers, any number of units may be mounted side by side in a common hole; entire button and light assembly removable from front of panel; mechanical interlocking for master resetting; nomenclature on removable button.

J. R. Longstaffe Co. Ltd., Toronto.

Traveling wave tube amplifier 178

Produced by Menlo Park Engineering Co., this traveling wave tube amplifier provides a 30-db power gain from 12.0 to 16.0 kmc. It uses a permanent magnet twt, has power supply regulation better than 0.1% and maximum ripple of 10 millivolts. Total weight is 55 lb.

Radionics Ltd., Montreal.

Equipment—cont.

the entire system of up to 8 stations. The master can call and converse with any other station or stations in the system.

Staff stations have switching facilities which provide most of the features available at the master station. Indoor and outdoor sub-stations can receive and reply to calls from any master or staff station.

Industrial and Institutional Communications Ltd., Wallaceburg, Ont.

Radio tuner for am-fm 179

Model SB-2000A radio tuner has separate dial scales for am and fm that change automatically when the selector switch is turned. One tuning knob serves for both bands because of separate changeable dial scales. This tuner has been designed for direct installation in the model SB-100A unit of the Century Match-Mates System.

Seabreeze Mfg. Ltd., Toronto.

Stable power supplies 180

Stable high-voltage power supplies designed by Tullamore Electronics Corp. are applicable on precision spectroscopy and fast coincidence application using the new 14-stage photomultiplier tubes. Features contributing to stability are use of temperature regulated voltage standards, ac chopper amplifiers, high-gain dc amplifiers and regulated dc filament voltages.

The HV25 series has an output voltage range of 800-2,500 volts. The HV15 series has a range of 400-1,500 volts. Both types can deliver an output current of 8 ma and both have a polarity reversing switch.

Radionics Ltd., Montreal.

Phase lock demodulator 181

Model 8-100 receiver phase-lock demodulator offers a gain in telemetry receiver sensitvity by lowering the improvement threshold by at least 6 db. This is a minimum figure realized when all rdb carriers are received. The demodulator is specifically designed for use with standard 1,400 series receivers but may be modified for use with other models. No modification to the receiver is required.

Radionics, Ltd., Montreal.

RF power amplifier 182

This companion unit to the model 3115 transmitter is employed to achieve 25 to 100 watts rf power with as little as 2 watts input. Frequency range is 215-260 mc; temperature range is —55 C to +75 C; shock, 100 g, vibration, 20 g; from 20 to 2000 cps; altitude 0-70,000 ft.

Radionics Ltd., Montreal.

Video phase and gain equalizer 183

The VCE-1 (Ling Systems Inc.) is a differential phase and gain equalizing unit intended for use with video microwave links of any manufacture.

Measuring 3 in. x 5 in. x 6 in., it operates at video level and allows up to 15 deg. of differential phase and 3 db of differential gain correction anywhere in the system. Video loss varies from 0-16 db, depending upon amount of correction needed.

Tele-Radio Systems Ltd., Toronto.

Radio relay equipment 184

Communications by means of microwave transmission with repeater stations spaced at an average of 30 miles has become well established for long distance

For quiet listening 185

The Adaphone is a small unit for attaching to any radio or TV set to enable hard-of-hearing persons to listen without disturbing other occupants of the room. Persons with normal hearing can use it for late night listening since a switch is provided to cut out the TV speaker if desired.

Housed in a plastic case, the adaphone connects in the loudspeaker circuit via a matching transformer having taps between 2 and 10 ohms. It comes complete with earpiece, standard earmold and leads.

Multitone of Canada Ltd., Toronto.

circuits where reliability is the prime factor. Varied high density traffic and systems which can connect into transcontinental networks are now much in demand.

The DQ58 Radio Relay equipment operates in the 1700 to 2300 mc band, and it has been designed to provide one or more rf channels, each capable of handling up to 600 telephone channels or a color TV circuit. Limited drop and insert facilities, automatic changeover from standby to traffic, and twin path with automatic interconnection are optional facilities available.

Canadian Marconi Co., Montreal.

Transistor audio amplifier 186

The Lustraphone transistor audio frequency amplifier, model TPA/557 operates on a supply voltage of 12 vdc, and has a power output of 15 watts. Frequency response is ±3 db from 90 cps to 10 kc. Quiescent current is 300 ma and peak current is 2.25 amperes. Input impedance is 20 to 1,000 ohms, while output impedance is 15 ohms with other impedances available.

D & B Sound and Signals Inc., Montreal.

Microphone mixer units 187

Two microphone mixer units introduced by Lustraphone are fully transistorized. Model MU/577 has four input channels arranged to provide two low impedance microphone circuits and two high impedance circuits for turntable pickup and radio tuner. Maximum gain on the low impedance channels is approximately 20 db, with the gain on the high impedance channels designed to provide approximately the same level. Frequency response is substantially flat from 50 cps to 14 kc. Power is derived from a single miniature mercury cell which has an estimated life of 1,000 hours.

Model MU/483 is a 3-channel resistive network with a maximum gain of approximately 32 db. Frequency response is linear down to 30 cps. Input and output impedances are 20 ohms on each channel. The mixer units are suitably encased for desk-top mounting.

D & B Sound & Signals Inc., Montreal.

Impulse counter 188

The Sodeco pre-determining impulse counters subtract from any preset number back to zero. When all digit drums have reached the zero position a single pole double throw contact is operated. These counters are designed for operation by direct current impulses. After a counting run back to zero, the originally preset number reappears on the register when the pushbutton on the front plate is depressed. The type TCeZ4PE and TCeF4PE counters can be supplied for frequencies up to 25 impulses per second.

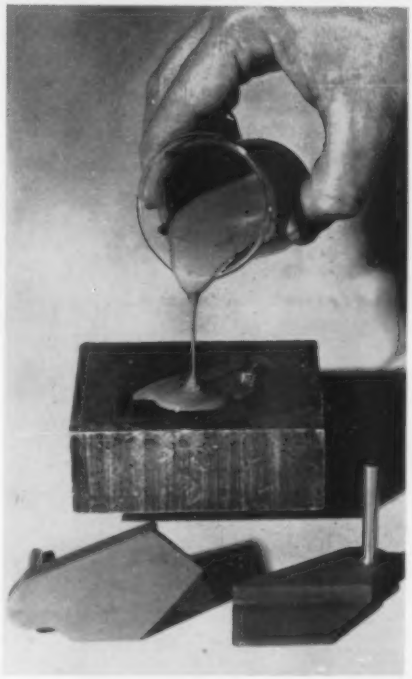
The J. W. Ellis Industries, Toronto.

Microwave absorber 189

Eccosorb CR is a casting resin which can be used to mold to size waveguide terminations, attenuators and loads. When cured, it has high attenuation over the full microwave frequency range.

When the two-component liquid system is properly proportioned and cast, the material can be cured at room temperature. It can be cured to a rigid plastic which will produce mold dimensions accurately. It can be machined.

M. J. Howard & Co., Ottawa.



Other products

Large stand-by power plant 190

Developed to maintain a constant source of power, this large capacity (85 to 380 kw) generating plant utilizes a flywheel to prevent interruption of power when converting from mains supply to emergency service. The basic unit comprises a Blackstone medium speed engine with an air-operated clutch, nodal damper coupling, flywheel of 5 ft. 9 in. diameter and alternator with direct coupled exciter. The engine is provided with fully automatic and remote control and protection and on resumption of mains supply is automatically synchronized. On failure of the mains supply, the air-operated clutch couples the flywheel to the engine and brings it to full speed immediately.

The initial speeding up of the flywheel from rest is accomplished by the engine starting on compressed air at 250 psi. Thereafter the flywheel is kept turning by the mains supply driving the alternator as a synchronous motor.

Canadian Lister-Blackstone Ltd., Toronto.

Scale dividing machine 191

This scale drawing and dividing machine automatically divides and draws single scales for electric and electronic instruments. Any type of flat or round scale with angular deflections up to 360 deg. may be handled. Between any two calibration points this machine will make linear, logarithmic constant increasing, or constant decreasing subdivisions.

Thermovolt Instruments Ltd., Toronto.

Laminated plastics 192

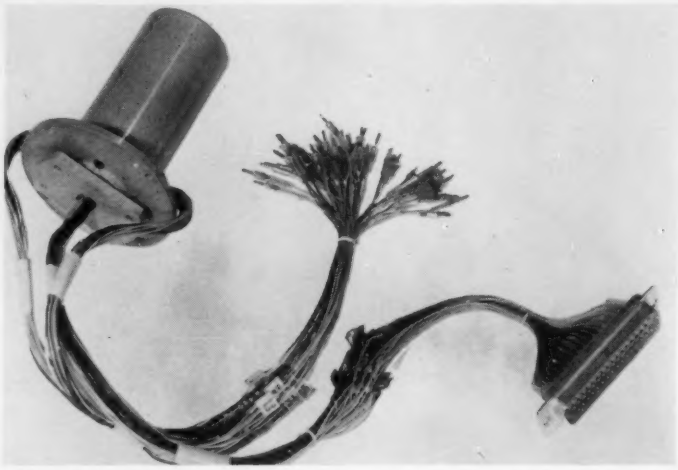
These are three new grades of laminated plastic. Phenolite grade EP-491 is an epoxy paper base material possessing electrical properties superior to standard XXXP types. The material is flame retardant, the grade is cold punching and is unaffected by gold plating baths.

Phenolite grade GB-890 is a Teflon bonded glass fabric type offering the highest heat resistance available. It has low water absorption, high insulation resistance and low dissipation factor over a wide frequency range. The grade XXXP-475 is a modified phenolic paper base grade offering flame retardant characteristics at moderate cost.

National Fibre Co. of Canada Ltd., Toronto.

Solder-type alloy 193

Eutec-Tin-Weld T-1 (AutoChemic) is a solder type alloy in paste form that



Slip ring assembly 194

During testing, all 40 circuits of this slip ring and brush assembly were tied in series and tested for noise. With 50 ma flowing, the total noise level of the 40 slip rings and 80 brushes remained under 2 millivolts after 1,000 hours operation at 500 rpm and a vibration of 10 cps.

Capacitance is less than 20 uuf and the insulation resistance is greater than 5,000 megohms circuit to circuit and circuit to ground.

E. S. Gould Sales Co., Montreal.

Other products—cont.

can be applied from a plastic squeeze bottle or through automatic applicator devices in larger production runs. It is not necessary to mix it before use because it has been formulated to avoid settling out of its heavier parts.

Eutectic Welding Alloys Co. of Canada Ltd., Montreal.

Non-corrosive liquid flux 195

A new organic liquid flux for soldering copper alloys and tinned metals has been developed and is guaranteed to have residue that is inert and corrosion free. Called EutecSol neutral flux number 808, it is formulated for lead-tin soldering applications. It is suitable for solders melting below 500 F and the residues are resistant to humidity and fungus.

Eutectic Welding Alloys Co. of Canada Ltd., Montreal.

High temperature lacing tapes 196

Gudebrod Bros. have developed two lacing tapes specifically for high temperature use. Both are flat braided from Teflon and are available in two forms. Temp-Lace H has a coating of synthetic rubber for superior knot security as well as for high fungus resistance. Preshrunk Temp-Lace is given a treatment which reduces shrinkage under extreme temperatures to a maximum of less than 3% after 16 hours at 200 C. Both are available in a wide range of sizes and are flexible in their entire range of —40 C to +220 C.

E. E. Whittaker, Arnprior, Ont.

Diffusion pump 197

High pumping speed, low back streaming and high fore pressure tolerance are features of the new Veeco type EP4W 4 in. diffusion pump. Pumping speed of the water-cooled, 3-stage pump is 420 L/sec at 5 x 10^{-5} mm Hg, and backstreaming is 0.04 cc/hr. at 25 C. The extra high limiting forepressure tolerance, 525 microns at 5 x 10^{-5} mm Hg, gives the pump good booster action qualities.

Radionics, Ltd., Montreal.

Epoxy conductive cement 198

A new conductive cement, based on epoxy resins and named Hysol 6250, is 100% solids. Volume resistivity is 0.01 ohm-cm at 25 C. Offering high bond strengths to most materials, the cement is recommended for repair of printed circuits and for bonding of electrical components where soldering cannot be tolerated.

The compound will cure fully in 24 hours at room temperature, or in two hours at 140 F. It is supplied in convenient kit form.

Hysol (Canada) Ltd., Toronto.

For more information on New Product and Catalogue items, use Reader Service Cards on pages 69 and 70

Weatherproof cabinets 199

Suitable for pole, crossarm or wall mounting, these all-steel weatherproof cabinets are available in three sizes providing usable rack space of 38¼, 55¼ and 73¼ inches. Front and rear doors have padlocked hasps and the ventilators have removable covers. The cabinets are finished in baked enamel over electrogalvanized 14 gauge steel.

Tele-Radio Systems Ltd., Toronto.

Decorative metal sheets 200

Spangle sheet is an aluminum alloy given a highly exaggerated and visible grain structure by a controlled mill process, during the finishing process, the grain structure is broken down into tiny satin and bright facets to create an overall decorative pattern within the material. It can be anodized and dyed gold as well as other colors.

Croweave is manufactured by embossing color and texture on almost any metal to simulate artistically woven cloth with threads of gold and silver. It can be produced in many colors, textures and weave patterns such as tweed, barkcloth and twill. Applications are decorative panels on radio cabinets, etc.

Croname Ltd., Waterloo, Quebec.

Self-supporting towers 201

These self-supporting towers for mounting tv receiving antennas, are being made with four different types of base. Heights are available from 14 to 67 ft. They can be placed anywhere on a person's property and avoid the problems associated with antennas mounted on roof tops.

Guide towers are also available to 150 ft in height.

Delhi Metal Products Ltd., Delhi, Ont.

Videotape splicer 202

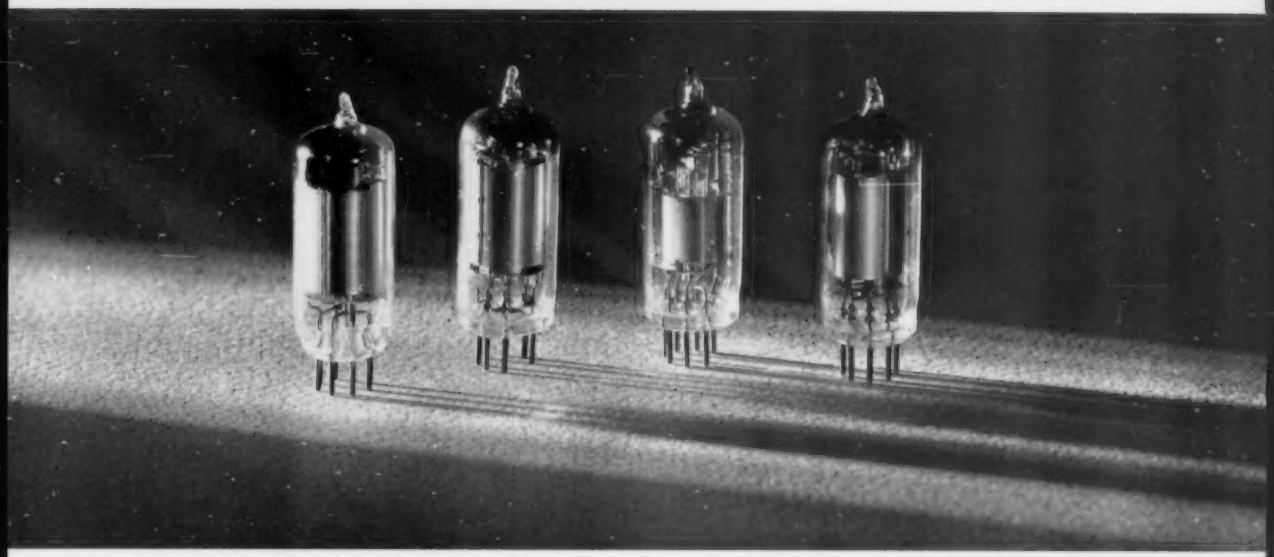
This is a semiautomatic splicer for making clean, roll-free splices on video tape. The model 1015 automatic tape splicer kit will include the automatic splicer supplied in a hardware carrying cabinet with compartments containing Edivue fluid, powder and pen; splicing and leader tape; blades; shatterproof glass shelf for mounting splicer on a Video tape console.

Ampex American Corp., Toronto.

Transcription turntable 203

The CH12 transcription turntable is engineered for professional use in broadcasting, television and recording studio applications. A rugged 1/100th hp hysteresis synchronous motor, dynamically balanced with the stainless steel capstan ground directly on its shaft, and a carefully designed drive system, ensure performance which exceeds NARTB specifications in all categories. Speed ranges are 33 1/3, 45, and 78 rpm.

McCurdy Radio Industries Ltd., Toronto. END



On behalf of the electron tube

D. S. SIMKINS, P.ENG.*

Since many electron tube failures are due to causes other than tube defects, the important factors in tube selection and application are examined, with particular attention to temperature ratings and variation of characteristics during tube life. Special quality tubes are defined, and recommendations made to equipment designers and end-users

No doubt there are those among us who say "thank goodness for semiconductors, now we can get rid of tubes!" One reason for coming to this somewhat premature conclusion could be an unfortunate past experience with tubes. Is it a fact that they are as bad as some people paint them, or in our quest for "what's new" have we failed to familiarize ourselves with what we have? Undoubtedly some of the troubles experienced with tubes are of our own making, since about 50% are through misapplication and 50% through the incorrect choice of the tube itself.

It should be recognized that a tube can only fail for one of two reasons, namely:

a) that it is a good tube operated outside its design parameters, or

b) that it has been fairly treated, and the tube is not up to its specifications.

In the former case it is an application engineering problem, and in the latter a tube manufacturing problem. We should become more aware of why tubes fail, not the mere fact that they do.

What then may we expect from the hot cathode oxide coated types? Firstly we need to determine accurately what our needs are, as a tube manufacturer, equipment designer, or equipment end-user. It is no use asking for rugged tubes when we really want reliable tubes. The three categories of main use, are:

a) Entertainment functions requiring tubes adequate for the job but built down to a price, where failure is a matter of low replacement cost and inconvenience at worst.

b) Military applications which may call for very stringent limits on certain parameters — parameters which are not important in other applications. Price is not necessarily a first consideration, but correct functioning is.

c) Sandwiched between these two markets is the very wide and important professional tube field comprising all types of communications and industrial control. Price and function are both important considerations. First cost is not the only monetary factor involved. Failure of equipment due to tube failures can produce high secondary costs when production lines are halted or, in the case of some communications equipment human life is endangered.

Special quality tube classifications

A galaxy of terms are used to describe tubes having some desirable properties over and above the general run of entertainment types.

Historically the **rugged** tube was the first major attempt by the tube industry to do something about the mechanical weakness in the tubes which were then used in aircraft equipment. No attempt was made to control electrical characteristics.

The **reliable** tube, however, was the result of efforts to limit both electrical and mechanical failures with a view to achieving a higher probability of reliability in a given equipment.

A **rugged** tube is therefore one whose rate of failure for mechanical reasons is low but whose rate of failure due to electrical defects is no different from the standard product. A **reliable** tube is one for which certain claims

*Rogers Electronic Tubes & Components, a Division of Philips Electronics Industries Ltd., Toronto.

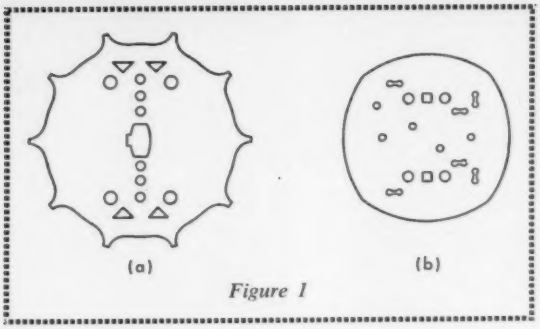


Figure 1

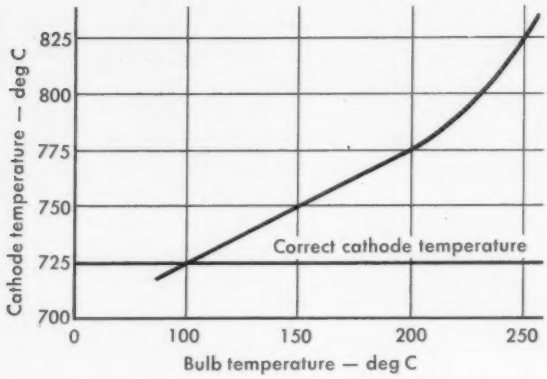


Figure 2

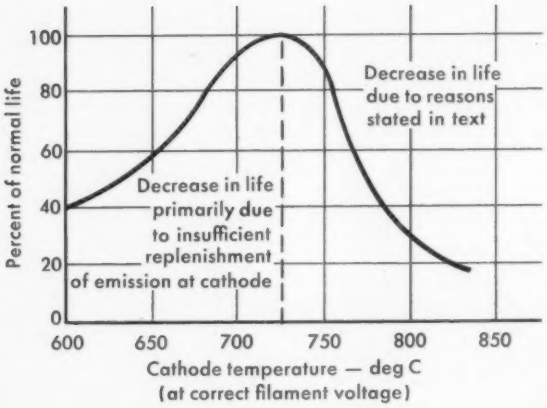


Figure 3

are made concerning the probability of the tube continuing to operate satisfactorily under stated conditions.

The rugged tube only has any real advantage in conditions where vibration and shock may be encountered, such as in mobile and aircraft equipment. Where an equipment maker or user requires to improve tube reliability (and consequently equipment reliability) in equipment that is not subject to vibration and shock he should ensure that the tubes are "reliable" and not just "rugged."

There are many terms used to describe either of these types of tube such as "Premium quality," "Special quality," "Professional," "Plus," etc.

Tubes which come into the category of "Special quality" are reliable tubes as defined above, and most types are rugged also. The features built into the tubes are such that life, under correct operating conditions, will exceed 10,000 hours.

Mechanical advances

Figure 1 illustrates one of the important improvements in mechanical structure that have been incorporated in rugged tubes. The drawings show the old (a) and the new (b) designs of mica spacers. The new form has no fragile pieces around its perimeter and therefore is not so likely to flake or chip.

Normally the inside diameter of the tube envelope is parallel and a close fit on the serrated mica spacer. In the new design the envelope is somewhat larger in diameter than the mica spacers, and is constricted onto the top spacer after the electrode assembly has been inserted.

This is a very advantageous method of construction since the assembly is in no way distorted until it has arrived at its final position. This is very important in tubes whose characteristics are critically dependent on geometry. Most deterioration due to vibration shows up when there is some initial movement which may be made worse; where no initial movement is possible, deterioration does not normally result.

Cathode temperature important

The nominal cathode temperature is about 725 C at the correct filament voltage. This temperature is far more critical than is generally realized. Variations of plus 10% can produce cathode temperatures around 780 C that cause rapid deterioration of cathode life down to about 60% of the possible. Ten percent under-running reduces the cathode temperature by an approximately equal amount and cathode emission demands must be proportionally reduced if cathode damage is not to result.

Cathode temperature and therefore tube life is also affected by the bulb temperature, irrespective of the contribution to cathode heat that the filament makes. Fig. 2 shows the effect of bulb temperature on cathode temperature in a typical oxide coated miniature tube. This leads to Fig. 3 which shows the effect of cathode temperature on life. Two typical examples are as follows:

a) At 100 C bulb temperature and at correct filament voltage the cathode temperature is correct at 725 C. If the bulb temperature increases to 200 C (not uncommon in much industrial equipment), the cathode temperature increases to 770 C. From Fig. 4 it can be seen that this reduces the normal average life to 70%. These conditions combined with a filament over-voltage of 10% would reduce the life to approximately 35%.

b) At a bulb temperature of 250 C the cathode temperature would be 280 C, reducing the life to 20% of normal average. These conditions combined with a 10% increase in filament voltage would reduce life to only a few hours.

The obvious result therefore of excessive bulb temperature is greatly reduced life, and this is brought about primarily by:

a) Increase in cathode temperature.

b) Release of gas from glass or other electrodes which damages the cathode by positive ion bombardment.

c) Vaporation of the getter deposit which redeposits on colder surfaces and causes leakages between electrodes.

d) Positive ion current flow in grid 1 as a result of gas, which reduces the bias voltage and may cause overdissipation if R_{g1} is high.

Another detrimental factor arising from elevated cathode temperature is the phenomenon known as "interface." Inter-face, also known as "sleeping sickness," is the development with time of a resistance between the cathode coating and the sleeve onto which the coating is

deposited. The rate at which this occurs is dependent on the cathode temperature and the amount of work that the cathode has to do. It therefore shows up more rapidly in tubes which are operating on stand-by operation than in those which are not. Tubes designed for this type of operation should be used if possible. If such tubes are not available it is advisable to use types of sufficient capacity to meet the current requirements when derated to give a lower cathode temperature.

Recommendations resulting from these considerations are:

a) The filament voltage should be kept within ±5% of the correct value.

b) The bulb temperature should preferably be around 125 C although good lives can be had up to 160 C. It is important that bulb temperatures be measured under the exact conditions in which the tube is intended to be run, that is with tube shields in place and the unit with its case on and in its final location. The modern method, using temperature paint, is quite simple and reliable. There is a very good proprietary brand on the market known as "Tempilaq."

c) There are specialist manufacturers who provide suitable shields that will reduce bulb temperature. The increased cost of a better shield may appear unwarranted, but if it saves the cost of even one tube it will probably more than compensate for its higher initial cost, let alone the cost of interruption of service.

Other important factors

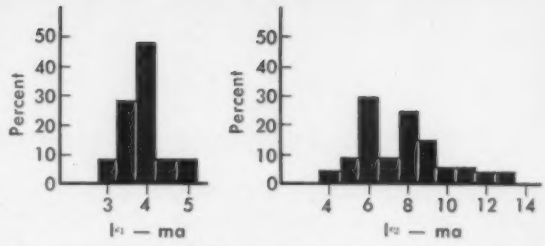
Other factors can produce bad running conditions which affect the life of the tube. This is particularly true of multi-element communication types where the mode of operation requires the control grid as well as the screen grid to run positive. Typical tubes are: 5894, 6252, 6360, 6939, 6146, 6083, 807, 829B, 832A, 4X150A, 4X250B.

In the published dynamic performance figures for any tube typical operating conditions are normally shown for frequency multipliers and power amplifiers, both modulated and unmodulated. Certain parameters are fixed, and other parameters result from these conditions. The independent parameters, over which we have control, are plate voltage, screen voltage, grid 1 voltage, and plate current. The parameters over which we have no direct control are grid 2 current and grid 1 current.

The manufacturer does not stipulate how the grid 1 and grid 2 voltages shall be derived, leaving the equipment designer free to achieve the necessary figures under the most economical commercial conditions. In tubes employing tungsten and thoriated emitters, the differential between the plate and screen voltage is usually fairly large, and a separate grid 2 supply is usual. However, in oxide coated emitters, where more emission is available, and lower supply voltages result, the grid 2 voltage is normally derived by using a dropping resistor, and the dc bias obtained by self-rectification of the incoming signal through the grid leak.

With fixed values of R_{g1} and R_{g2} it follows that only one value of grid 1 current, and one value of grid 2 current, can represent the correct voltage figures. This in turn requires that every tube both during its life, and from tube to tube, has identical current divisions.

To supply tubes having identical current divisions would mean very small productivity and consequently enhanced tube costs. In practice, the current division does vary from tube to tube, and from batch to batch. These variations of grid 1 and grid 2 current may not be ignored, and should be compensated for by a change of R_{g1} and R_{g2}. This will give the constant values of V_{g1} and V_{g2} that are necessary to preserve constant input power, efficiency and output. To determine the spread of values of R_{g1} and R_{g2}



Figs. 4 and 5. Graphs showing the spreads in control grid current (I_{g1}) and screen-grid current (I_{g2}), measured on a batch of 6252 double tetrodes at a frequency of 150 mc. The tubes were adjusted to a plate voltage of 500 v, a screen-grid voltage of 200 v, and a grid bias of —60 v. The plate current was 100 ma. The currents measured are plotted horizontally and the percentage of tubes showing each current vertically.

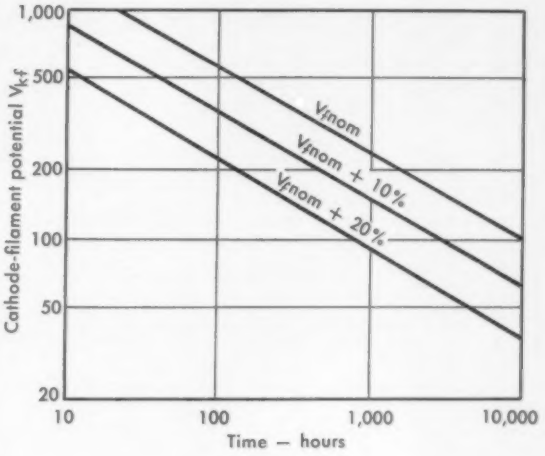


Figure 6

for a given tube type it is first necessary to obtain from the manufacturer the spread of I_{g1} and I_{g2} that may be expected under a typical set of dynamic operating conditions (see Figures 4 and 5).

Both R_{g1} and R_{g2} may be infinitely variable or a tapped series chain, whichever is more compatible with the commercial design. Only by following this procedure it is possible to get constant output over wide ranges of tubes. The alignment procedure should be that at the point of maximum output the grid 2 voltage should read as prescribed, and the plate current with a fixed amount of rf drive should be adjusted by means of R_{g1} to a constant figure.

Cathode to filament voltage

Figure 6 shows the relationship between V_{kf} (filament positive) and the time in which 1% of a batch of tubes develop filament-cathode shorts, with the filament voltage as parameter. The values are for guidance only, having been obtained by extrapolation of accelerated tests carried out at higher voltages and temperatures. It can be clearly seen how the life of a tube is shortened by raising V_{kf} and how this is influenced by the filament voltage. It can be seen that V_{kf} should not exceed 100v if a life of 10,000 hours is required.

(Continued on page 62)

Military component development in Canada

Defence Research Board supervises coordinated program

HAROLD PRICE, EDITOR*

New and improved electronic components (tubes, transistors, capacitors, resistors, etc.) are essential to advances in electronic equipment. On this matter the Defence Research Board is advised by the Electronic Component Research and Development Committee (ECRDC). The committee advises the board on the development of electronic components, and associated research, with the object of meeting or anticipating defence requirements. To this end the committee's functions comprise:

(a) Recommending a continuing and co-ordinated program of development and research, having regard to the programs of, and in liaison with, other agencies with similar functions in U. K. and U. S.

(b) Considering technically the requirements of Crown corporations and agencies, other than those concerned directly with the defence program, with a view to co-ordination of research and development effort.

(c) Assisting the Defence Research Board in the technical supervision of contracts placed as a result of ECRDC recommendations.

(d) Recommending means whereby Canadian sources of components might be established, provided this is justified by procurement forecasts, particularly where such a step is a necessary preliminary to meeting development requirements.

(e) Making recommendations, where necessary, on other matters which affect the development program.

The term "electronic component" covers those parts customarily so denoted including electronic and electromechanical devices, and materials especially employed in this general field.

Membership

ECRDC members are appointed as individuals having knowledge of, or special interest in electronic components. Although it is not intended to have permanent representation from all departments that may have a requirement or problem, nevertheless the membership is drawn from a variety of departments or government corporations. This has the advantage that non-defence activities are taken into account in making recommendations for defence purposes.

As of August, 1958, ECRDC included representatives of the following organizations: Atomic Energy of Canada Ltd.; Canadian Arsenals Ltd.; Canadian Broadcasting Corp.; Dept. of Defence Production; Dept. of Mines and Technical Surveys; Dept. of National Defence, including Air Materiel Command (RCAF), Army Development Establishment, Canadian Military Electronics Standards Agency (CAMESA), Canadian Armament Research and Development Establishment (CARDE), Defence Research Telecommunications Establishment (DRTE), and Electrical Engineer in Chief (Navy); Dept. of Transport; National Research Council; and the Ontario Research Foundation.

Working policy

An ECRDC working policy has been formed to match the special conditions prevailing in Canada. Broadly, a project falls into one of three categories, where different considerations apply:

(i) Development of a specific item is considered from several points of view:

(a) the future importance of the item to defence electronic equipment.

(b) the industrial position and capabilities—including commercially available items.

(c) developments in hand in U. S. and U. K. and elsewhere, which are studied before embarking on a project to prevent unnecessary duplication of work.

(d) standardization concepts, both domestic and international.

(ii) Research is aimed to provide knowledge as the foundation for future advances. A limited budget means that fields of work have to be carefully chosen to give the maximum possibility of useful outcome. Other important criteria are whether the potential contractor is himself making a research investment along related lines—when continuity will be assured to a greater degree—and the existence of research staff of proven capability. On occasion, a project can be recommended for work in a government laboratory. Whenever possible work is made to complement that of U. S. and U. K.

(iii) Provision of new sources. ECRDC has no general mandate to recommend setting up sources of existing components not now available in Canada: this is done only when

(a) further important developments are thus made possible, and

(b) an economic future for the source is assured by procurement forecasts.

Program

The committee's program began with two contracts placed in the latter half of 1954, and 1956/57 saw some projects coming to completion. The table opposite summarizes the program, and the following notes give some details of the various projects.

In general, the aim is a stable program that will attract and keep talented people. Projects are selected so as to provide knowledge and experience that can be widely

*Based on information provided by Mr. J. W. Webber, Secretary ECRDC, DRTE/EL., Defence Research Board, Montreal Road, Ottawa, to whom all enquiries should be addressed.

Electronic Component Research & Development Committee
Synopsis of program

	Completed	In hand	Probable future lines
Electron devices	Reliable miniature tube 5654/6AK5W Hydrogen thyratron 5C22 with improved life	Subminiature electrometer tube	Study of electron beams Display devices
Microwaves	Improvements to magnetron reliability (applicational)	Improvements to magnetron reliability (cathodes) A novel backward wave oscillator/amplifier	Parametric amplifiers High power tube windows Ceramic loaded TWT
Semiconductors	Subminiature germanium diodes for fast switching	Subminiature silicon diodes for fast switching Study of breakdown and avalanche in semiconductors	Study of reduction of carrier life-time Study of intermetallic compounds, especially for thermoelectric application
Parts	Standard size tantalum capacitors Fixed wire-wound resistors Variable composition resistor (¾ in. dia.) Investigation of fixed composition resistors Investigation of solder-sealing of quartz crystal units	Aluminum electrolytic capacitors Button mica capacitors Air dielectric trimmers Triple-ganged capacitor Concentric trimmer Investigation of variable composition resistors Variable composition resistors (⅜ in. dia.) Investigation of general purpose relays	Miniature wet sintered slug tantalum electrolytic capacitors Button ceramic film capacitors Ruggedized 1 mc quartz crystal Investigation of sensitive relays
Materials		Synthetic quartz Barium-titanate-based materials Infrared materials Formation of oxide films on metals	Zirconates, Niobates

applied. Increased exchange of ideas between university and industrial research groups is encouraged.

The program is on a financially modest scale. Projects are looked at critically, and contractors are expected to bring certain talents and facilities to bear on a problem. There is little capital assistance or payment for production machinery. On these bases, cash is not a primary limitation at present.

The emphasis on applied research with defence implications is being increased relative to development of "items." This seems to be the wisest long-term course in the Canadian situation.

ELECTRON DEVICES

Reliable receiving tubes

The object was to encourage the general provision in Canada of the more reliable and rugged receiving tubes needed for military equipment—particularly for airborne and for vehicular uses—by initiating work on one type, and so providing a general body of techniques readily applicable to other types of tube in this class. The contractor has met the immediate objective by obtaining Qualification Approval for 5654/6AK5W (a miniature RF pentode) and is concluding his work with a study of the ultimate limits of endurance of his tube under extreme

environmental conditions; the latter is intended both to lead to improved construction techniques and to provide application data of use to equipment designers. The ultimate objective—provision of reliable tubes generally in Canada—has been referred to the Dept. of Defence Production, and it is now certain that such supplies will become available.

Magnetron reliability

In Service radars expensive magnetrons often fail after very short lives or are even defective initially. It was intended that a specialist study of applications, failures and certain known good magnetrons would

(a) suggest improvements which could be built into Canadian tubes, and
(b) provide immediate application advice to improve lives obtained from other makes of magnetron.

Four tasks related to ground and airborne equipment have been set with the co-operation of various RCAF departments. The first of these has been concluded satisfactorily, while work on the others is either in hand, or just beginning. A fifth task is of a research nature into a cathode problem.

It is expected that this type of work will enable much more than the cost of the contract to be saved. Effort will be made available for any other problems which may be encountered.

(Note: Following the commercial re-introduction of magnetron manufacture into Canada for the first time since the 1939-45 war, these types are now made and approved for military use: 4J31 to 4J35, 4J53, 2J42, 6764 to 6769 while 4J50, 5J26 and 6027 are expected to follow before long.)

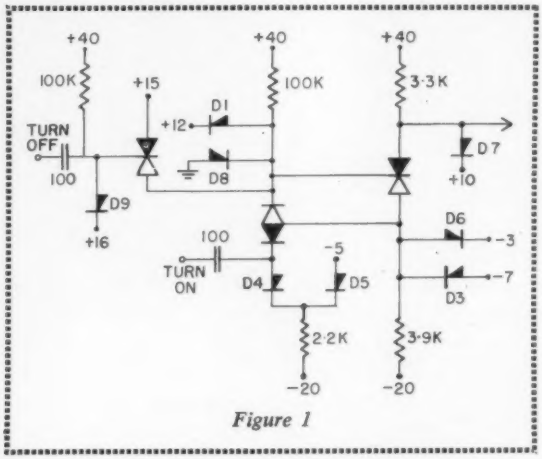


Figure 1

Germanium diodes for faster circuits

Figure 1 is a diagram of a typical transistor circuit—in this case a trigger unit devised by the Digital Computer Group of DRTE. It will be seen that there are eight diodes to three transistors; this ratio is at times higher. The diode is an important element of transistor circuitry, however, in more than a quantitative fashion. Its "turn-off" time (that is, the finite time it takes to become a non-conductor when voltage on it reverses after a period of conduction) can act as a limit to the speed of the circuit's action. Although at present adequate, this property of the diode could restrict the faster transistors promised for the future. There is no doubt that faster "real-time" operation of military data handling circuits will be required in future.

For the above reasons, a line of work has been instituted on "faster" diodes. Completed projects established a fairly conventional diode (approved as 1N126) in a hermetically sealed glass envelope 0.3 in. long and 0.14 in. diameter; and investigated the effects of bonding the whisker to the germanium, achieving a turn-off time of about 100 millimicroseconds. A further project (now placed) is aiming at the 1 to 10 mus region.

Hydrogen thyratron 5C22

Work is now completed on this tube, which has enhanced life as a result of including a special hydrogen replenisher.

Low power microwave tube research

Development in this field has been commenced. Experimental samples of a special form of backward-wave-oscillator have been successfully made, and are enabling certain new methods of microwave operation to be explored. The initial aim is not to make "production" tubes, but to assist system research and development groups to exploit their ideas, which previously could be frustrated by lack of specially devised tubes.

PARTS AND MATERIALS

Tantalum electrolytic capacitors

Large capacity values in a relatively small space are required to operate over a fairly wide temperature range. The tantalum electrolytic capacitor is the most promising unit to fulfil these conditions, although somewhat expensive compared with paper capacitors. Work has progressed satisfactorily on the training of research staff and the setting up of the development facility to the stage where standard size units using sulphuric acid as the electrolyte are being made.

The next stage contemplated is the research and development of miniature wet sintered slug types for operation at 125 deg. C.

Button mica capacitors

These capacitors are used because of their small size and superior high frequency performance. A major problem with mica capacitors is the effect of ingress of moisture, and emphasis has been placed on the development of a hermetically sealed unit. A glass-metal seal appears to meet the desired requirement. A Kel-F seal is also being tried.

Subminiature, variable, air-trimmer capacitor

Subminiature panel-mounting trimmer capacitors, operating at voltages up to 150 volts and at temperatures between —55C. and +125 C. are required. Two capacitors with ranges 1.5 to 10 uuf and 5 to 50 uuf have been designed and samples have been made. These samples are now undergoing tests.

Small variable composition resistor

This project aimed at the development of a ¾ in. dia. control, to be rated at ½ watt, 70C. with a rotational life of 25,000 cycles. Qualification Approval has been granted to the unit developed which is now in production. Tests have shown that the unit developed could be rated at 1 watt, 85C. for 50,000 rotations.

Composition resistors—fixed and variable

A study has been made on the effect of various environments on fixed resistors, and a Final Report has been issued.

An equipment for indicating and recording noise in variable composition resistors has been developed. The investigation of variable composition resistors under different environmental conditions has just started.

Fixed wire-wound resistors

Miniature, high power, wire-wound resistors have been made with values up to 3.5K for 4 watts rating, and 8.4K for 7 watts rating. Trouble has been experienced on the higher values up to 4.7K, 4 watts rating, and up to 15K, 7 watts rating, due to shorted turns.

Investigation of solder-sealing and seal testing of quartz crystal units

The first phase in the development of a leak detector has been completed and requests for models and design information have been received from U. S. and U. K.

The investigation of solders, case materials and soldering techniques has shown that the end result depends to a large extent upon the care taken by the operator during the soldering operation. Pressure tests have been carried out on the bases of the metal-cased units. Ultra-sonic soldering has also been tried. A method of testing glass-enclosed units for leaks has been evaluated.

Subminiature ganged capacitor

Models of a triple-ganged capacitor have been made with a range of 5 to 35 uuf for each section and with overall dimensions of 2¼ in. by ¾ in. by ¾ in. approximately, excluding shaft projections. Evaluation tests are being carried out on these models.

Subminiature, multiturn, cylindrical air-trimmer capacitor

The feasibility of developing a capacitor with a range of 1-8 uuf, but having greater resistance to shock and vibration than the glass-piston type of capacitor has been studied. Models are being made to meet service requirements.

Ruggedized quartz crystals units

Crystal units have to be rugged to meet the service demands for operational use under severe conditions of bounce, shock and vibration. The design of a rugged unit is not always compatible with the design of a good resonator, and this is particularly true of the 1 mc crystal units. Metal-cased units, size HC-6/U of U. S. manufacture have been tested and these failed to meet the specification. A glass-enclosed design has also failed to meet the requirement. Another commercial design is being considered for tests.

Subminiature, adjustable locking-type resistors

Following the successful development of a ¾ in. diameter control, the knowledge and experience is being used to develop a ⅜ in. diameter control rated at 1/3 watt, 70C. Experimental samples have been tested. It is doubtful whether 1/3 watt rating can be achieved with the present design.

Synthetic quartz

Some material from U. S. and U. K. is being studied.

Deterioration of transformers

A study of these deterioration of transformers has been made and a Final Report has been issued which includes a number of recommendations for further investigations. Three of these recommendations have been accepted for further study and these are:

1. an attempt to find a short-cut Arrhenius procedure for determining the life of certain types of transformers,
2. investigation of materials used in these designs and
3. the consideration of Arrhenius integrators as means of determining the used life of transformers.

Investigation of general purpose relays

A study is being made of the literature and existing types of relays are being examined with a view to recommending promising lines of approach for the design of improved types of relays.

Study of oxide film formation

A basic study of the formation of oxide film on metals such as tantalum, aluminum, niobium and related metals has been undertaken with a view to understanding and improving the operation of electrolytic capacitors. The findings of these investigations are being considered with a view to the applications by capacitor manufacturers. The results of the study have been published from time to time in accredited journals. This project has attracted the attention of workers in this field in the U. S. and U. K.

Aluminum electrolytic capacitor

A research program has commenced on the study of aluminum electrolytic capacitors to obtain better characteristics at the lower temperatures.

Research and development tests on components and materials

Tests on components and materials developed on ECRDC Projects are being carried out by a test group to obtain data which will lead to a better understanding of the designs of components. Extended tests are being performed on components to determine weaknesses in designs, to assess reliability under operating or special environmental conditions and to indicate means or methods of improving components. The test facilities are also being used to save effort by the development contractor and to economize on test equipment.

Research and development on barium titanate-based materials

Work has commenced on the study of the literature and investigation of materials in an attempt to obtain supplies of materials with consistent characteristics. An attempt is being made to obtain pure barium titanate and then to add other elements to produce new materials. These materials when developed are expected to give more consistent and better electrical characteristics when used in electrical components.

Investigation of barium titanate-based materials using X-ray techniques

Ceramic materials, particularly new materials developed on the project mentioned above, will be studied using X-ray techniques to try to obtain an understanding of the relationship between the structures of the materials and their electrical characteristics.

Evaluation of PEM and PC infrared detectors

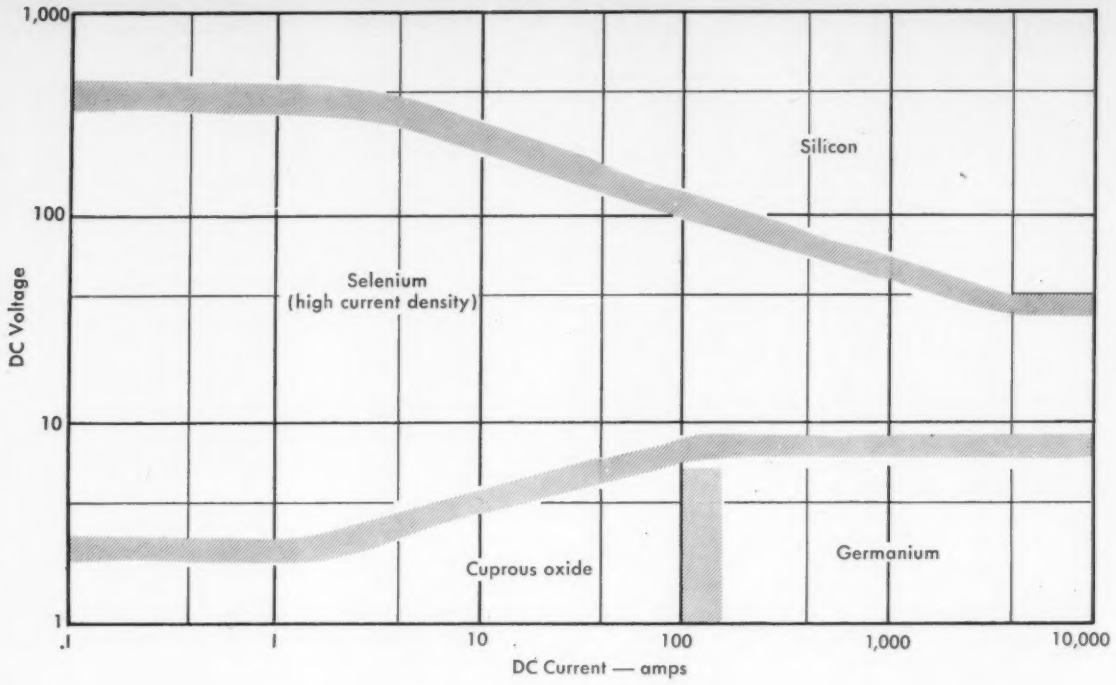
A comparison of photo-electromagnetic and photo-conductive room temperature infrared detectors when used under conditions likely to be encountered in service is required.

Study of doped-germanium infrared detectors

Work has commenced on the study of doped-germanium photo-conductive detectors.

Thin ceramic film button style capacitor

A proposal for the development of processes and techniques for making a thin ceramic film button style capacitor as a sealed unit is being considered. A large capacity in a small volume for use in transistorized circuits is required. The button style capacitor is also expected to meet requirements for high frequency applications. END



How to select semiconductor rectifiers

A. M. HASE, MEM.I.R.E.*

Physical properties and forward and reverse characteristics are examined for the four most common semiconductor rectifier materials: cuprous oxide, selenium, germanium and silicon. This leads to definition of the best areas of application for each type of junction, including the newer high current density selenium p-n junctions

Due to the rapid advances in the semiconductor rectifier field, the designer of rectifier equipment is often left in a state of bewilderment and confusion when confronted with the problem of selecting the proper type of rectifier for a certain application. Five to ten years ago the choice was relatively simple and the decision was almost entirely based on the required output voltage. For low voltage (2-6v) applications, cuprous oxide (Cu_2O) was used and for higher voltages (up to a few hundred volts), selenium (Se) was an able performer.

However, with the discovery of the semiconductor p-n junction and the subsequent development of highly efficient germanium (Ge) and Silicon (Si) devices, the selection has become more difficult, particularly when one considers the thermal properties of the new devices.

This article attempts to list and assess the important properties of semiconductor materials and junctions, and to guide the designer of rectifier equipment.

*Canadian Line Materials Ltd., Toronto

The table lists the relevant properties of the four basic semiconductor rectifier materials. Their forward and reverse characteristics are shown in Figure 1.

The characteristics of p-n junction rectifiers can be expressed by:

$$I = I_o [\exp. (eV/kT) - 1] \quad (1)$$

where I is the current density in amps/cm², I_o is a constant determined by the semiconductor properties (such as lifetime of minority carriers, mobility and resistivity), e is the electron charge, V is the voltage across the junction (— for reverse and + for forward), k is the Boltzmann constant and T the absolute temperature.

The equation is in fair agreement with practical results. The lack of current saturation in the reverse direction of Si junctions is caused by the low lifetime of minority carriers. Some Ge and Si junctions have a p-i-n structure and their forward characteristic follows the equation: $I = I_o [\exp. (eV/2kT) - 1]$. Other deviations and discrepancies which influence the electrical characteristics of semiconductor junctions are known but have little bearing on what follows.

In the equilibrium state when n=p approximately, and $n \times p = n_i^2$

$$I_o \sim n_i^2 \sim \exp. (-EG/kT) \quad (2)$$

where EG is the intrinsic energy gap in eV and n_i is the intrinsic carrier density in cm^{-3}. From equation (2) it can be seen that I_o decreases rapidly with increasing energy gap. Thus one would expect that the use of materials with high energy gap, such as Si, would lead to much larger junction areas. However, this is not the case, since Si can

Material	Ge	Si	Cu_2O	Se
Lattice structure	Cubic single crystal	Cubic single crystal	Cuprite polycrystalline	Hexagonal polycrystalline
Energy gap—ev	.75	1.12	1.4	2.1
Type of carrier	p-n	p-n	p only	p only
Dielectric constant	16	12	11	6.3
Intrinsic carrier density n_i at 300 deg K — cm^{-3}	2.5×10^{13} approx.	2×10^{10} approx.	1×10^{17} approx.	7.5×10^{15} approx.
Intrinsic resistivity at 300 deg K — ohm.cm	48	275,000	750 approx.	12,800 approx.
Mobility at 300 deg K $cm^2.volt.sec^{-1}$ n-type	3600	1200	1 approx.	1 approx.
Mobility at 300 deg K $cm^2.volt.sec^{-1}$ p-type	1700	450		
Threshold voltage	.4	.75	.3	.65
Slope resistance — $ohm.cm^2$	1.2×10^{-3}	1×10^{-3}	2 approx.	1.5 approx.
Reverse voltage — v_{rms}	25 - 150	50 - 1000	2 - 6	26 - 33
Current density $amp.cm^{-2}$ convection cooling	40	75	.05	.05 - .075
Current density $amp.cm^{-2}$ fan cooling	100	150	.15	.09 - .20
Max. operating temperature — deg C	85	220	75	75 - 175
Watt efficiency — percent	95 - 99	91 - 99	60 - 80	93 - 96
Life expectancy — hours	Infinite	Infinite	50,000	100,000
Overload capacity	Very small	Small	Large	Very large

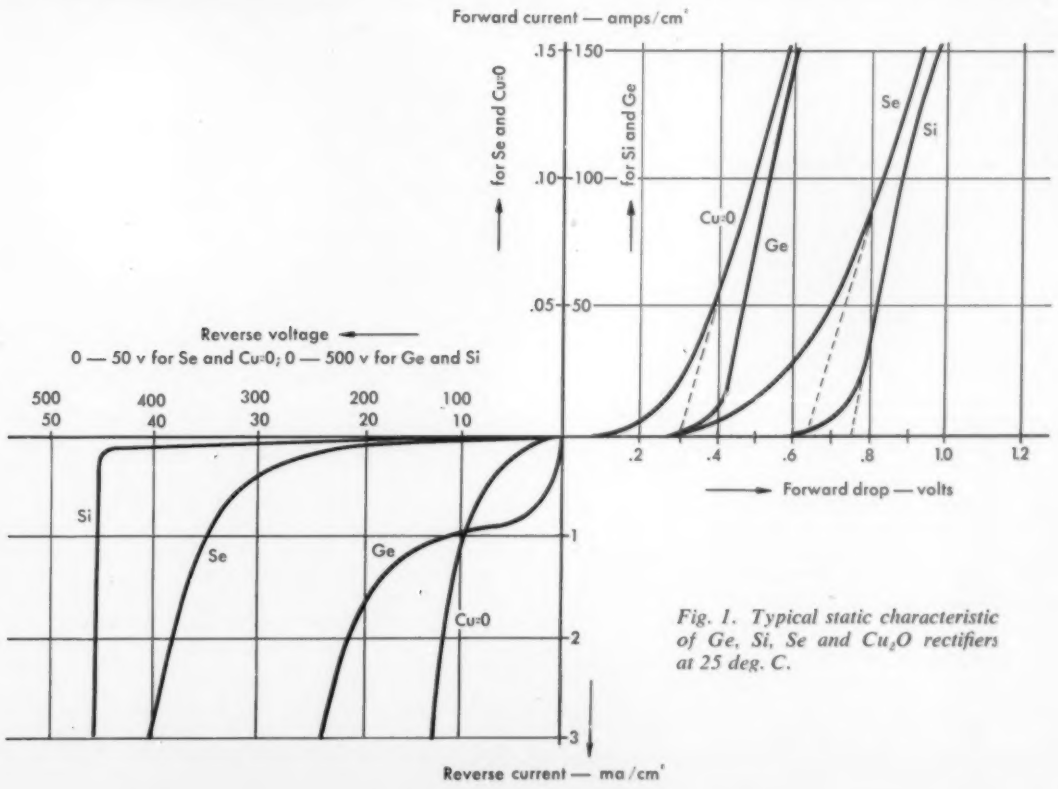


Fig. 1. Typical static characteristic of Ge, Si, Se and Cu_2O rectifiers at 25 deg. C.

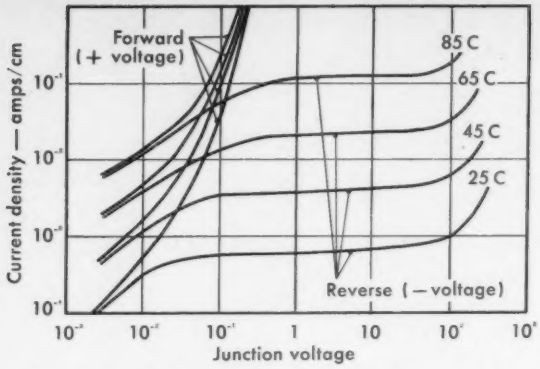


Fig. 2. Typical current-voltage characteristics of a germanium p-n junction

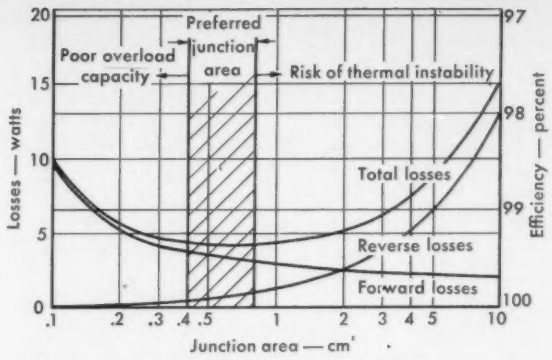


Fig. 3. Losses and efficiency of a germanium rectifier as a function of the junction area

be operated at much higher temperatures — up to about 220C. On the other hand, the operating temperature of Ge must be kept below 85C, preferably around 65C, to avoid the thermal instability which can be caused by the rapid increase in reverse current with temperature. Figure 2 shows the variations of the forward and reverse characteristics of a Ge junction with temperature.

This temperature behaviour presents a real problem to the designer of Ge junctions and is best illustrated in Figure 3, where the forward and reverse losses of a typical Ge rectifier are shown as a function of the junction area. To avoid the problem of thermal instability (runaway) the reverse losses should not exceed approximately 25% of the total losses. This forces the designer to use a small-area junction of rather limited heat capacity.

Due to the wider energy gap, the reverse current in Si junctions is of much lower magnitude and thermal instability is less likely. However, since Si junctions can be used for much higher reverse voltages and possess much "steeper" reverse characteristics than Se and Ge junctions, the ability of Si junctions to absorb the energy of transient voltages before the breakdown voltage is reached is very small. Therefore transient voltages can very easily bring destruction or damage to Si junctions. In case of damage, a permanent increase in reverse current often occurs and the problem of thermal instability returns.

Losses important

Another important factor which largely governs the dimensional design of semiconductor rectifiers is shown by the following equation:

$$NT = \underset{\text{sect. 1}}{(V_{th}.I_{dc}.k)} + \underset{\text{sect. 2}}{(R_s.I_{dc}^2.k)} + \underset{\text{sect. 3}}{(V_{rms}.I_r.f)} \qquad (3)$$

NT are the total losses of a diode in watts, V_{th} is the threshold voltage, R_s the slope resistance in ohm . cm², I_{dc} the dc output current in amps, k a factor describing the degree of forward conduction, V_{rms} the effective reverse voltage, I_r the average value of the reverse current in amps and f a form factor, controlled by the waveshape of the reverse current and the degree of reverse conduction.

As indicated in equation (3), the total losses of any semiconductor junction can be divided into three sections. Sections 1 and 2 represent the "forward" losses and section 3 the "reverse" losses. Section 1 is controlled by V_{th} and varies only linearly with I_{dc}. Since silicon has a V_{th} of .75 volts compared with .4 volts for Ge, it has almost twice the loss of Ge, but, as mentioned before, Si can be operated at much higher temperatures and these extra losses can readily be absorbed and dissipated. The losses in section 2 are controlled by R_s and increase with the square of I_{dc}. Since the slope resistances of Ge and Si are of the same magnitude (see the table), the losses are also of the same order and there is no need to increase the junction area of Si rectifiers as predicted by equation (2).

As shown in the table the slope resistance of Ge and Si junctions is approximately 1,000 times lower than the slope resistance of Se and Cu_2O junctions. **This is the only reason why Ge and Si can carry so much more forward current per unit area than Se and Cu_2O.** The main reason for the high slope resistance of Se and Cu_2O must be sought in their very low carrier mobility (approximately 1 cm² . volt . sec^{-1}).

The larger area of selenium rectifiers is not necessarily a disadvantage. On the contrary, it is of great value in the case of overload, since heat can be absorbed and dissipated much more quickly than from Ge and Si junctions. In fact, it is necessary to attach the more efficient Ge and Si junction to heat sinks and cooling fins to absorb and dissipate the heat even under normal load conditions. The overload capacity of such an arrangement is still much below that of Se and Cu_2O junctions. Hence, the need arises to protect Ge and Si junctions by fast-acting fuses and circuit breakers, thermal control systems and other protective devices. These in turn tend to decrease the over-all efficiency and are still subject to failures and require maintenance. The alternative is to apply Ge and Si junctions at much below their reverse and forward ratings.

New selenium units

Recently developed p-n junction selenium rectifiers capable of operating at twice the current density (NEMA current density is used as a basis) have become available. Reviewing this latest arrival in the semiconductor rectifier family, in the light of the above considerations, it appears that this new rectifier fills the gap which exists between the highly efficient Ge and Si junctions with small heat capacity and the less efficient and bulky Cu_2O and standard Se rectifiers with ample heat capacity. This gives the designer a new tool in solving his rectification problem for low and medium voltages, while maintaining such desirable features as high efficiency and large overload capacity.

The final decision on what type of semiconductor rectifier should be used is often made on an over-all economic basis. The chart on page 48 represents an attempt to group the various rectifiers on this basis.

END

Canadian Aircraft Industry Instrumentation Symposium

GILBERT A. MILNE

Sir Robert Watson-Watt

The Instrument Society of America is holding a symposium in Toronto's Lord Simcoe Hotel, March 12-13, 1959. Entitled the Canadian Aircraft Industry Instrumentation Symposium, the meeting is being organized by the Toronto section of ISA.

Under the theme, The Nature and Status of Instrumentation in the Canadian Aircraft Industry, 24 technical papers will be presented and four workshops held. It is planned that the complete texts of the papers will be available before the symposium. Delegates will therefore have the opportunity to come armed with questions and will be able to further consolidate their conception of the papers through examination of speaker's exhibits and contact with the authors. All the papers to be presented are of Canadian origin and will report Canadian accomplishments and thinking.

The workshop sessions have been chosen to deal with instrumentation design and operation fundamentals. The workshop atmosphere of free discussion will allow delegates to get down to brass tacks on these subjects.

To further increase technical interchange and establish personal contacts throughout the industry, private conferences are being arranged. An ISA official will have available a roster of experienced and specialized delegates to whom he can direct those delegates seeking a more expert opinion or an informed discussion.

Following the opening luncheon, Sir Robert Watson-Watt, CB, FRS, will keynote the meeting with his talk "The Importance of Being Just Clever Enough." A full and varied ladies' program has been arranged. There will also be a number of private showings of instruments in manufacturers' suites.

PROGRAM

THURSDAY MARCH 12

10.00 - 12.00 a.m.

Registration

12.00 - 1.30 p.m.

Opening Luncheon
Speaker: Sir Robert Watson-Watt, CB, FRS

2.00 - 5.00 p.m.

Data handling systems for the NAE high-speed intermittent wind tunnels.
J. W. Tanney, National Aeronautical Establishment, Ottawa.

Instrumentation of Argus aircraft for Canadair stability control flight test.
S. Furster, Canadair Ltd., Montreal.

A review of the theory of sampled data systems.
D. W. Lewis, Avro Aircraft Ltd., Malton, Ont.

Self-shielded ratio meter.
H. A. Leah, Bach-Simpson Ltd., London, Ont.

Some considerations in the design of rectilinear, repeater type aircraft panel instruments.
A. Ranford, Honeywell Controls Ltd., Leaside, Ont.

An airborne flight progress indicator.
E. B. Moss, Canadian Applied Research Ltd., Toronto.

A multi-channel strain gauge recorder for aircraft static structural tests.
J. Leak, Canadair Ltd., Montreal.

Engine altitude test facility instrumentation.
J. J. Cowley, Orenda Engines Ltd., Malton.

A modular approach to the hardware needs of airborne instrumentation.
C. K. Barnes, Avro Aircraft Ltd., Malton.

6.30 - 8.30 p.m. Workshops

Electronic data recovery — when and why.
T. A. Stenning, Avro Aircraft Ltd., Malton.

Practical accuracy.
V. Davidson, Canadair Ltd., Montreal.

Human engineering in instrumentation.
W. E. Franks, RCAF Institute of Aviation Medicine, Toronto.

Directly recorded or computed measurements.
H. P. Koehler, Orenda Engines Ltd., Malton.

FRIDAY MARCH 13

2.00 - 5.00 p.m.

The multiple input bridge as a control system component.
Dr. C. D. Boot, Orenda Engines Ltd., Malton.

Dynamics of jet engine control.
J. M. Tusiewics and P. D. Griffiths, Lucas-Rotax Ltd., Scarborough, Ont.

The low cost stable platform.
O. S. Davidge, Sperry Gyroscope Co. of Canada Ltd., Montreal.

Precision electronic test instrument calibration.
A. Findlay, Canadian Aviation Electronics Ltd., Montreal.

Semi-automatic data reduction techniques.
P. Shevloff and P. H. Friedlander, Canadair Ltd., Montreal.

Reader-plotter machine for transposing oscillographic records to graph paper.
D. S. L. Durie, The De Havilland Aircraft of Canada Ltd., Downsview, Ont.

Development of a high speed, high temperature slip ring.
R. B. Jay and L. J. Bardwell, Orenda Engines Ltd., Malton.

A high speed torquemeter for use on a VTOL ducted fan test rig.
H. S. Fowler, National Research Council, Ottawa.

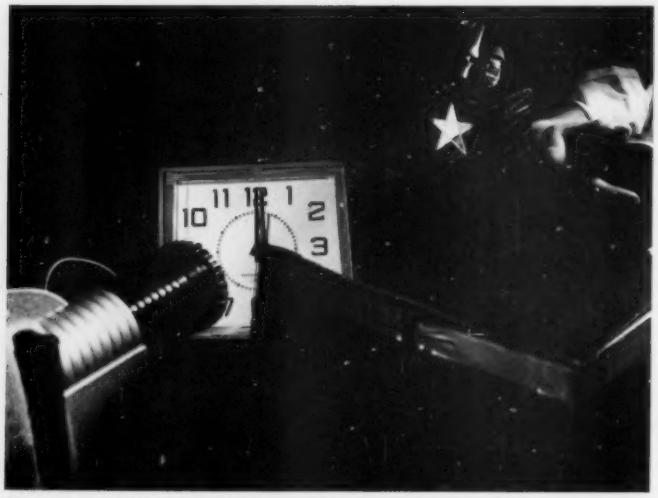
Development of a small, inexpensive recording micro-accelerometer.
W. E. Franks and G. A. Meek, RCAF, Toronto.

(Continued on page 57)

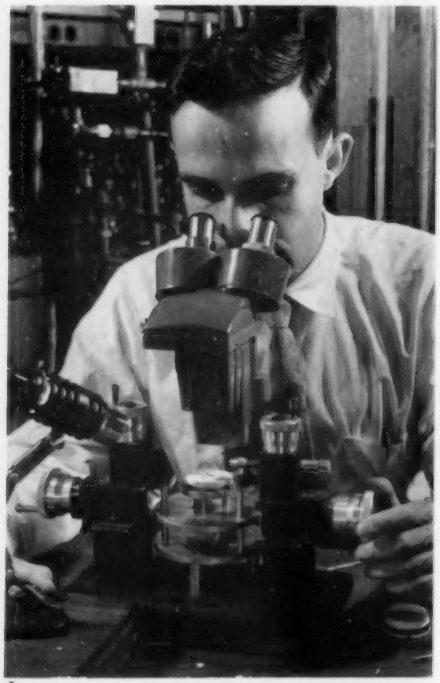
What's new in view

General Electric Research Labs display some of their projects

Dr. H. R. Philipp examines a high-vacuum tube used in measuring photoelectric emission from germanium crystals. Samples may be induction heated in the long glass arms for outgassing, then slipped into the central ball where measurements are made.



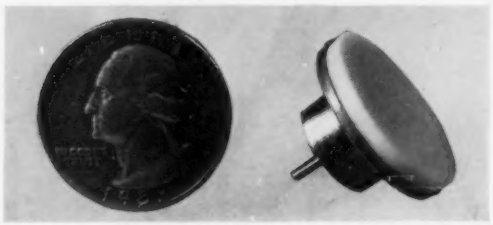
In demonstration of image storage, projector at left casts a star image on screen at right. After incident ultraviolet light is cut off, image remains visible on the screen as the result of a dc field which is applied to it. Clock shows relative size.



Dr. Vernon L. Newhouse, physicist, uses a micromanipulator to modify the structure of an evaporated metallic film in a device for studying superconductivity phenomena.

Physicist Gerald W. Ludwig prepares to insert a silicon crystal into a microwave cavity to study electron spin resonance. In the background is some of the extensive microwave equipment used in this research work.

Dr. Oliver H. Le Blanc, physical chemist, observes the operation of a purification train during the preparation of exceptionally pure liquid n-hexane used in research on dielectric liquids in electron trapping.



This new high vacuum thermionic converter, made of metal and ceramic, been reduced to size of quarter

Man's new explorations in space have created demands for specialized sources of power. One of the best combinations of compactness, simplicity and output exhibited to date is the thermionic converter.

Dr. N. Rey Whetten and Dr. A. B. Laponsky (right) are engaged in the study of secondary electron emission. Recent investigations have presented significant new information, particularly as a result of work on single crystals of magnesium oxide.

For your library

Electronics will be used more widely in process plants

Automatic Measurement of Quality in Process Plants

Proceedings of a conference sponsored by The Society of Instrument Technology; Butterworth & Co. (Canada) Ltd., Toronto; 320 pp; $9.50.

Reviewed by B. Stapley, P.Eng., Electronic Associates Ltd., Willowdale, Ont.

This book combines 25 papers presented at Swansea, England by a group of experts including instrument designers and manufacturers, instrument users and research workers from universities and other establishments. These papers have been divided into six groups entitled, "The Adaption of Laboratory Techniques to Plant Measurement," "Some Techniques for Gas Stream Analysis," "Liquid Stream Analysis," "Spectrometric Method," "Some New Techniques For Fluid Stream Analysis," and "Measurement of Some Physical Properties."

This book has considerable value for any electronic engineer involved in the design and development of instrumentation for measurement and control. The 25 papers provide an up-to-date survey of the established quality control techniques used in process plants and laboratories. In addition the development of a number of on-stream systems to perform functions now characteristic of essentially laboratory techniques is suggested.

The subject matter of these papers has been presented with a minimum of mathematics. Advanced specialized theoretical treatment has been avoided. Consequently an electronics engineer is easily able to obtain fundamental information in a great variety of specialized fields with which he would not normally be familiar.

Although the use of radioactive material in measuring and control systems is a relatively new technique, it has already become firmly established in several industries. Due to the rapidly increasing rate of installation of radio isotope instrumentation the paper, "The Use of Nuclear Thickness Gauges in Automatic Quality Meaurement and Control," will be of particular interest. This paper provides an excellent general background on this subject as well as listing references for further study.

Electronic Avigation Engineering

Peter C. Sandretto; (International Telephone and Telegraph Corp.) Standard Telephones & Cables Mfg. Co. (Canada) Ltd., Commercial Dept., 9600 St. Lawrence Blvd., Montreal 12, Que. Single copy price is $9.50 postpaid; in lots of 12 or more, price is $8 each.

The author has taken the exact definition in selecting the title for his book. Avigation is defined by Webster as "the scheme or art of conducting aircraft in flight from one point to another." Navigation, strictly speaking, applies to ships.

The problems associated with avigation are divided into four main categories by the author. These are the en-route long-distance zone, the en-route short-distance zone, the approach and landing zone, and the airport zone. Taking each of these, the author discusses the problems encountered, in relation to the objectives and the environment. Interesting and valuable history is introduced to give the reader a better understanding of the subject, particularly the reason why certain decisions were taken in the past, how they affect present-day operations.

Specific types of equipment are discussed—Loran, airport surveillance radar, etc.—to give the reader examples of how certain problems have been solved. The author recognizes that equipment designs change rapidly, so he has kept these parts to a minimum, using them to help clarify remarks on the engineering principles involved.

Nonlinear Problems in Random Theory

Norbert Wiener; The Technology Press of M.I.T. and John Wiley & Sons, Inc., New York, N.Y.; 131 pp; $4.50.

Reviewed by Dr. J. E. Hogarth, Defence Research Telecommunications Establishment, Ottawa.

Professor Wiener's monograph is the first of a proposed series of M.I.T. Technology Press Research Monographs designed to bridge a gap between journal articles and finished books. It was prepared in a most unusual fashion—from tape and photographic recordings of fifteen lectures given by the author to a selected group of graduate students in electrical engineering. The text retains the structure and the informality of the lectures. The latter at first sight appears distracting, but later, in the midst of rather heavy material, the reader will welcome the relaxation afforded by light Wienerisms.

The first four lectures are devoted to the development of the subject and the next three apply to Frequency-Modulation Problems.

The eighth lecture, involving random time and coupled oscillators with application to brain waves, represent the author's chief motive for the development of the work. A model is attained for the phenomenon of the dip in the spectrum of non-linear coupled oscillators in the neighborhood of the central or driving frequency.

After a brief digression to parallel mathematical properties of quantum

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theory, the next four lectures represent the heart of the material from the engineering viewpoint. A non-linear counterpart of Fourier analysis is developed, with network analysis and synthesis described in terms of the response to a Brownian or shot-effect input.

The monograph ends with the author's tentative and incompleted work in the field of statistical mechanics.

This book will be of interest to applied mathematicians in a great variety of fields who wish to push beyond the limits of linear theory. It is unfortunate that a more extensive bibliography is not included.

Principles of Electronics
Second edition

H. Buckingham and E. M. Price; Cleaver-Hume Press Ltd., London; 419 pp; about $2.25.

In their preface the authors state that this book is not written for students making a specialized study of electronics, but will provide a grounding for those following a general electrical engineering course.

They also state that "The first five chapters are devoted to the basic facts and theory underlying electronic work. Some of the concepts here may be a little difficult of comprehension, but this is inherent in the nature of the subject and need not deter the reader from proceeding."

If the concepts are difficult to understand, much of the blame rests with the authors. Too much material has been condensed into these introductory pages with the result that the reader is left with many dissected facts and thoughts. It would have been better to refer the reader to a good text on basic atomic physics, then proceed from there.

As it now stands, the book fulfills its intended role from chapter six onward. These pages describe the principles of tubes, semiconductors, particle accelerators, electron microscopes, power rectifiers and a variety of other commercial and industrial devices. These descriptions are skillfully presented using minimum words with clear illustrations. This part of the book justifies its existence.

Catalogues and Brochures

Flexibar metal framing system for wiring and pipe runs is described, and component parts listed in 20-page brochure. Burndy Canada Ltd., Scarborough, Ont. (204)

Instrumentation for cable makers is 4-page short-form catalogue of instruments used in manufacturing of cables. The Addison Electric Co. Ltd., London. (205)

Magnetic circuits are described in detail in Vol. 6, No. 1 of Applied Magnetics. The Indiana Steel Products Co. of Canada Ltd., Kitchener, Ont. (206)

Technical description of the Stromberg-Carlson S-C 5000 M-10 registration buffer for high-speed data readout; 7 pages. Hackbusch Electronics Ltd., Toronto. (207)

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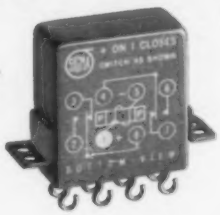

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Defense contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parenthesis indicates the number of contracts, the amount being the total value.

December 16-31, 1958

Ampex American Corp., Ottawa, tape recorders, $137,977.

Bayly Engineering Ltd., Ottawa, tubes, $11,719.

Canadian Arsenals Ltd., Ottawa, fire control equipment, $108,152.

Canadian General Electric Co. Ltd., Toronto, tubes, $50,716.

Canadian Marconi Co., Toronto, tubes, $23,789.

Canadian Westinghouse Co. Ltd., Ottawa, equipment, $20,306.

Collins Radio Co. of Canada Ltd., Toronto, equipment, $422,151 (2).

Computing Devices of Canada Ltd., Ottawa, aircraft instruments and navigation equipment, $1,260,330.

Domac Technical Sales Ltd., Ottawa, equipment, $18,760; cable assemblies, $38,000.

Instronics Ltd., Stittsville, Ont., equipment, $234,852 (4).

Philco Corp. of Canada Ltd., Don Mills, Ont., technical services, $60,-125; equipment, $11,512.

Sperry Gyroscope Co. of Canada Ltd., Montreal, tubes, $25,152.

Cossor (Canada) Ltd., Halifax, transmitting facilities for radio station — Coverdale, N.B., $30,633 (contract awarded by Defence Construction (1951) Ltd.).

January 1-15, 1959

Alpha Aracon Radio Co. Ltd., Toronto, components, $19,500.

Bogue Electric of Canada Ltd., Ottawa, transformers, $10,316.

Canadian Aviation Electronics Ltd., Montreal, equipment, $18,452.

Collins Radio Co. of Canada Ltd., Toronto, components, $33,286.

Computing Devices of Canada Ltd., Ottawa, technical services, $24,805.

Field Aviation Co. Ltd., Ottawa, airborne transmitter-receiver equipment, $45,136.

For more information on New Product and Catalogue items, use Reader Service Cards on pages 69 and 70

People—continued

Regional managers

Two appointments to the position of regional manager have been made at Philips Electronics Industries Ltd. **Mr. L. O. McLaren** has been appointed regional manager of Philips Winnipeg branch. Mr. McLaren joined the company in 1949 as sales representative in the Ontario region. In 1954 he was appointed sales manager of the Ontario branch.

WILLIAMS

Sheldrake

McLaren

Appointed regional manager of the Vancouver branch, **H. R. Sheldrake** joined the company in 1950 as a service technician. He became sales representative in 1953.

Executive at United-Carr Fastener Company

Two executive appointments of United-Carr Fastener Company of Canada, Limited, Hamilton.

J. Robert Johnston, formerly general sales manager, becomes vice-president in charge of sales. Mr. Johnston, who has served as branch manager in Montreal and Winnipeg, joined the company 22 years ago.

George J. Muir has been appointed secretary-treasurer. Mr. Muir has been assistant treasurer since 1952, and has also held a number of administrative positions during his 24 years of service in the head office of the company.

Johnston

Muir

IRE Toronto section continues to grow

Chairman of the Toronto section of the IRE, H. F. Shoemaker, has announced that the membership in the section now exceeds 590, excluding students. Among recent upgradings to senior members of **Mr. Bay Vural** and **Mr. Arthur Kingsnorth.**

Instrumentation symposium—continued

6.30 - 8.30 p.m.

A technique for minimizing the effect of temperature on transducer input and output impedances.
K. J. Bower, Avro Aircraft Ltd., Malton.

Design of Bourdon tubes.
G. Kardos, Aviation Electric Ltd., Montreal.

Obtaining the accuracy of individual static thermocouple calibration without its prohibitive cost.
G. H. Farrow, Orenda Engines Ltd., Malton.

An instrumentation system for ground resonance testing of aircraft.
H. C. Wooley, Canadair Ltd., Montreal.

Logging and processing flight information from the Iroquois gas turbine engine.
W. B. Davey, D. F. Cooper and W. D. Coats, Orenda Engines Ltd., Malton.

Testing of an integrated navigation and flight instrumentation system on a modern Canadian transport aircraft.
H. Halton, Canadair Ltd., Montreal.

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Reports—continued

International Systcoms formed in Montreal

International Systcoms Ltd. is a new Canadian electronic engineering company. The organization is headed by **J. J. Kingan,** who is an ex-vice-president of EIA.

BATTEN

Kingan

The new company will be active in the planning of communications systems and in the design and manufacture of communications equipment. Initial product releases have been made in the field of vhf mobile equipment. W. Ornstein is manager of commercial products and is responsible for new product development; F. J. Looker is production manager.

In announcing the formation of the company, Mr. Kingan stated "The basis of our operations is our confidence in the continuing rapid growth of radio communications in Canada. We believe that an important role can be played by Canadian companies in planning Canada's future communications systems and in the design and manufacture of equipment to be used in these systems."

Chicago now linked to Canada by Telex

Greetings messages whisked back and forth between Chicago and Canadian cities Feb. 10 during inauguration ceremonies of a new Telex service.

The inauguration established Chicago as a Telex exchange point, and officially started service between Chicago and 23 Canadian cities already in the Telex network. New York was the first U. S. city to join the network when service to that point began last May.

In the Toronto ceremony (see picture) **Jean Ward** of Simpsons-Sears Ltd., largest commercial subscribers in Canada, shows Telex dialling system to **W. J. Adams,** seated, vice-chairman of Canadian Chamber of

Adams, Ward, Steele

Commerce executive council, watched by **R. B. Steele,** Canadian National Telegraphs general superintendent.

DOT commissions new GCA system

A new Ground Control Approach system, installed at Gander, Nfld., has been commissioned by the Department of Transport.

Seen here at the controls of the new equipment are, left, W. H. Heath, officer in charge, Gander Aeradio Station, and J. G. Scammell, chief air traffic controller at Gander.

Heath and Scammell

Electronics firms appoint reps.

Scientific-Atlanta Inc. products will be marketed exclusively in Canada by Philips Electronics Industries Ltd., Toronto (antenna pattern recording equipment).

Peter J. Heenan Ltd., Toronto, will handle distributor sales in Eastern Canada for Centralab components. This is in addition to Heenan's previous responsibility of industrial sales in the same territory.

Pixberg & Company, West Germany, are represented in Canada by Canadian Research Institute, Toronto (all types of resistance wire).

RHOMBIC ANTENNA suitable for community TV distribution system. Large size available at low cost. Also distribution equipment cheap. Write P.O. Box 5015, Department K, London, Ontario.

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"For detailed information send for Bulletin G.6."

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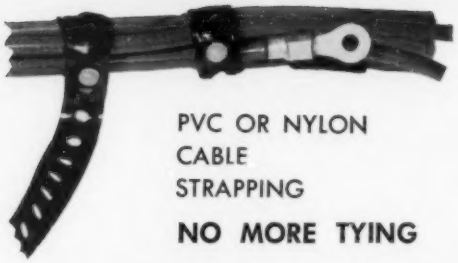

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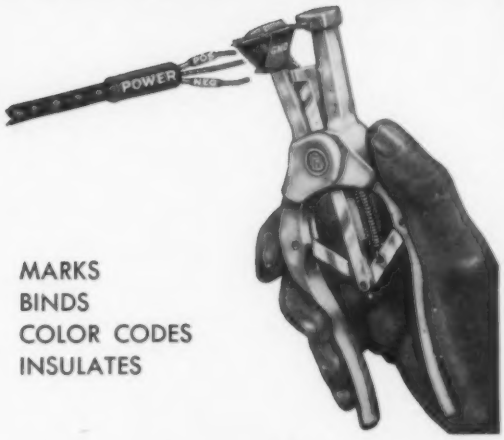

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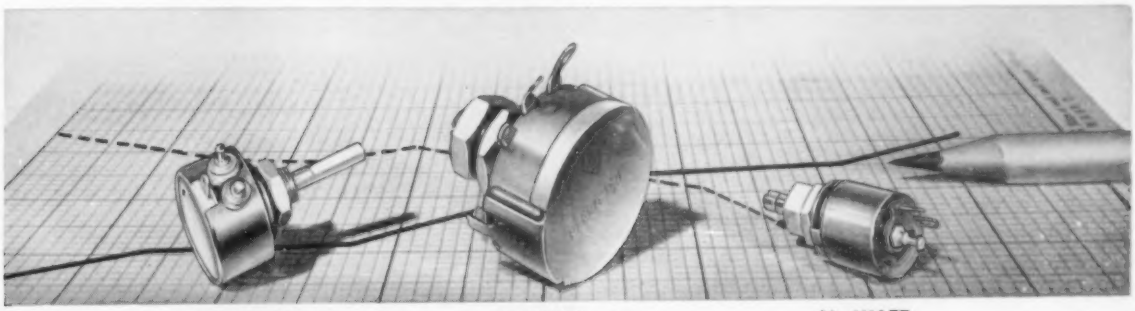

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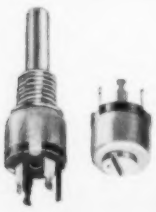

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Electron tube — continued

RECOMMENDATIONS

Specific recommendations based on the factors outlined above can be made to both the designers and end-users of professional equipment. These are listed below.

Designers

1. Ascertain at the time of your initial considerations the specific end-of-life characteristics of the tube. This information can be supplied by the manufacturer — a typical example is shown in Table 1. If the tube selected is available from more than one manufacturer, a correlation between the different brands should be made. After all, your customer is the party eventually faced with the replacement problem; you only have it as a transitory problem.

Parameter	Typical values	End-of-life values
Plate current I_a, ma	3.0 ± 0.5	less than 2.0
Screen-grid current I_{g_2}, ma	0.65 ± 0.2	" " 0.35
Mutual conductance S, ma/v	1.85 ± 0.35	" " 1.2
Negative grid current $-I_{g_1}$, ua	0.1 max.	at least 0.2

Table 1. Typical and end-of-life characteristics of pentode type 6084

2. If your requirements are for long periods of stand-by, consider tubes designed specifically for this mode of operation or request recommendations for larger derated tubes.

3. Find out the spread of the dependent parameters such as grid 1 and grid 2 currents, particularly when circuits are designed with fixed parameters such as dropping resistors and grid leaks. Without this knowledge only difficulty can result from the purchase by the end-user of tubes from several sources, whose parameters differ widely in this regard.

4. Keep the minimum value of grid resistance in all cases. When your requirements call for tubes of the electrometer variety, discuss these with the tube manufacturers first. Some very good tubes are available in this category.

5. Seriously consider a reduction in the number of types in a given equipment, even if this gives slightly less than optimum performance per stage. This improves the over-all situation in terms of inventory costs, productivity due to volume, availability, uniformity, and cost.

6. Alternate tube line-ups should be offered to the customer, who will then have the choice of paying the difference in cost between special quality and standard tubes.

7. Application engineering information and help is available from the tube manufacturer and should be sought.

End-users

1. When buying new equipment the initial price and specification are the apparent factors involved. It is advisable to make sure from your own or consulted engineering services whether the conditions of use in your particular location (vibration, temperature, hydro voltage, etc.) are such that the equipment will fully meet your reliability requirements. If the conclusion is that this is not so your equipment supplier should be requested to tender for equipments which take these factors into account. This will save money in the long run.

2. It may not be assumed that all tubes bearing the same type number are made equally well by different manufacturers. The real cost in tube replacement (not taking into account second order costs due to lost time and break-down) is the cost per life hour. Find out not only "how much," but also "how often," and in this way one can really determine "how little."

3. Many equipment suppliers are forced by competitive practices to ignore special quality tubes, even though they would considerably enhance the quality of the equipment. This often leads to a low initial price but also to a high replacement cost. The tube manufacturer's application engineering services are aware of alternate solutions such as the use of voltage regulators. While they are not directly concerned with marketing these devices, they are usually familiar with the sources of supply, available types, application details, etc.

Conclusions

The electron tube of today has reached a very highly specialized state of development and there are several classes of tubes resulting from this. The Special Quality group of tubes can be obtained with known initial characteristics and tolerances, known end-of-life characteristics and known mechanical features, subject to them being operated under conditions which can be clearly stipulated. These conditions are not unreasonable and minimum lives of 10,000 hours may be expected. When reviewing these statements against some of the current practices a big difference will be apparent.

The electron tube is not an unreliable product under fair operating conditions — the Special Quality tube is no answer to abuse. Information is available from industry and in the interest of all concerned it should be sought.

END

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The first selection will appear in the April issue.

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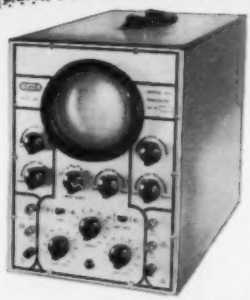

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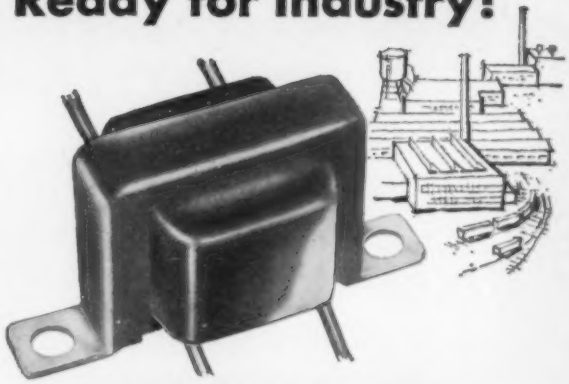

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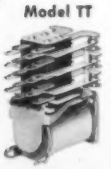

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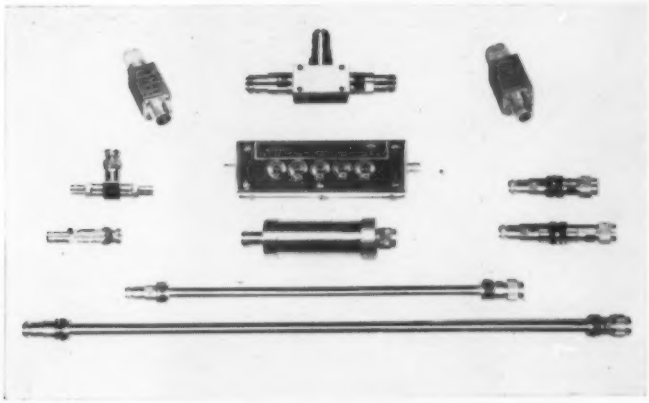

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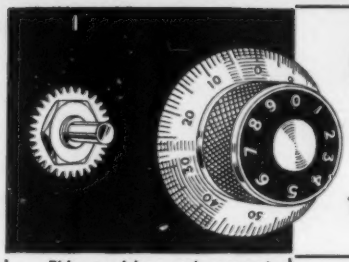

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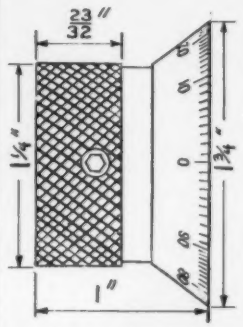

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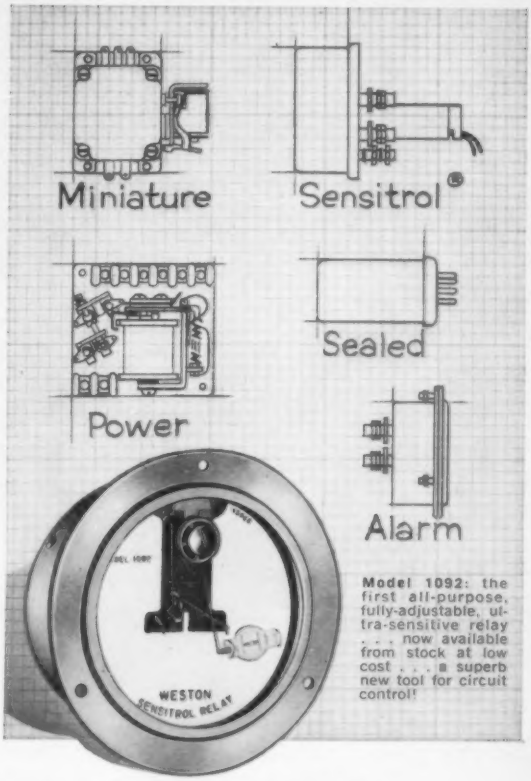
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Engineering speakers Ozawa, Alcock, Gibson and LeBer

Round up: news and future events

Students inject a fresh note into technical sessions

The Toronto sections of the IRE and AIEE have held their annual student papers competition. As usual, many of the section members turned out "just to encourage the students." As usual, the section members found that the meeting was one of the most fruitful events of the season.

First prize was awarded to P. V. Ozawa, a graduating student at the University of Toronto, who gave an excellent paper on multi-channel communication by pulse code modulation.

Other winners were: 2) A. J. Alcock, hall effect applications of semiconductors. 3) B. C. LeBer, racetrack odds computer. 4) J. H. Gibson, protective relaying of transmission lines.

Mr. LeBer represented the IRE Student Associate Branch at Ryerson Institute of Technology, while the other speakers represented the Joint Student Branch IRE/AIEE at the University of Toronto. Papers presented covered the students' theses.

Technical paper competition

In order that university undergraduates may become more familiar with the principles and techniques of standardization, The Hamilton-Toronto Section of the Standards Engineers Society have announced sponsorship of a technical paper award.

A paper, between 2,000 and 3,000 words on any aspect of standardization may be submitted before April 15th, 1959 to the Society by any undergraduate at present enrolled in an Ontario University.

An award of $25 will be made for the best paper submitted. The address is Standards Engineers Society, c/o M. J. McKerrow, Canadian Westinghouse Co. Ltd., P.O. Box 510, Hamilton, Ontario.

Human engineering

McGill University Staff Development Institute is preparing for the 1959 summer school. One course being offered this year is Human Engineering Institute. It is an instructional course for professional engineers engaged in the design of equipment. It will be conducted from September 9-19 by Dr. C. H. Baker and staff of Defence Research Medical Laboratories, Toronto. Fee is $375.00.

Information may be obtained from The Secretary, Applied Psychology Centre, McGill University, 3684 McTavish St., Montreal, Que.

Rockets and space travel

The first of two meetings on space travel will be held at the University of Toronto on March 16. D. C. Wallis will discuss rockets and space travel.

The meeting is sponsored jointly by the IRE Toronto Section, and the Canadian Astronautical Society.

Per ardua ad astra?

On February 20, the Avro Arrow program was stopped.

On February 21, buried amidst all the lengthy newspaper accounts of the Arrow, appeared this advertisement: . . . know where you're going . . . go aircrew. Make aviation your career in the RCAF. As a commissioned officer in the Royal Canadian Air Force, you will obtain flying experience and executive training second to none . . .

COMING EVENTS

March

17-21 Electrical Engineers Exhibition, Earls Court, London.

23-26 Radio Engineering Show and IRE National Convention. New York.

April

5-10 Fifth Nuclear Congress. Cleveland, Ohio.

6-9 British Radio and Electronic Component Show, Grosvenor House and Park Lane House, London, W.1.

16-18 Southwestern IRE Regional Conference & Electronics Show. Dallas, Tex.

16-30 Engineering, Marine, Welding & Nuclear Energy Exhibition, Olympia, London.

May

4-6 National Aeronautical and Navigational Electronics Conference. Dayton, Ohio.

4-8 National Industrial Production Show of Canada, Exhibition Park, Toronto.

6-8 1959 Electronic Components Conference. Philadelphia, Pa.

21-27 International Convention on Transistors. Savoy Place, London, W.C.2.

June

8-10 Canadian National Business Show, Exhibition Park, Toronto.

12-28 Electrama, general exhibition of the French Electrical Engineering Industries, including electronics. Paris.

Type OJ carrier telephone system

An open wire system developed in Canada for a grade of transmission consistent with direct distance dialing requirements on circuits up to 500 miles in length. This briefly describes next month's article by A. R. Harper of Northern Electric Co. Ltd.: A type OJ carrier telephone system.

M. A. Gullen of the Army Development Establishment, Ottawa, will present some fundamental design information in his paper on features of the admittance quadripole.

April will mark the start of a new series in CEE. Editor Harold Price will set the style for a group of articles providing information on companies in the Canadian electronics industry. He will start with Precision Electronic Components Ltd.

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DIGITAL VOLTMETER, $825

Automatic range and polarity selection. Just apply the probe and read voltage directly!

405AR DC DIGITAL VOLTMETER is a completely new instrument providing, literally, "touch-and-read" voltage measurements between 1 and 1,000 volts. *Range, even polarity, are automatically selected.* Readout is in-line, in bright, steady numerals.

New, novel circuitry provides a stability of readings virtually eliminating jitter in the last digit. This reduces operator fatigue and avoids uncertainty.

Special features include a floating input, electronic analog-to-digital conversion, digital recorder output and front-panel "hold" control permitting manual positioning of decimal. Voltage sampling rate is variable from 1 reading every 5 seconds to 5 per second; or can be controlled externally by a 20 v positive pulse.

BRIEF SPECIFICATIONS

Range: 0.001 to 999 v dc; 4 ranges.
Presentation: 3 significant figures, polarity indicator
Accuracy: ±0.2% full scale ± 1 count
Ranging time: ⅕ sec to 2 sec
Input impedance: 11 megohms to dc, all ranges
Response time: Less than 1 sec
AC rejection: 3 db at 0.7 cps; min. 50 db at 60 cps
Price: $825.00

Data subject to change without notice. Price f.o.b. factory.

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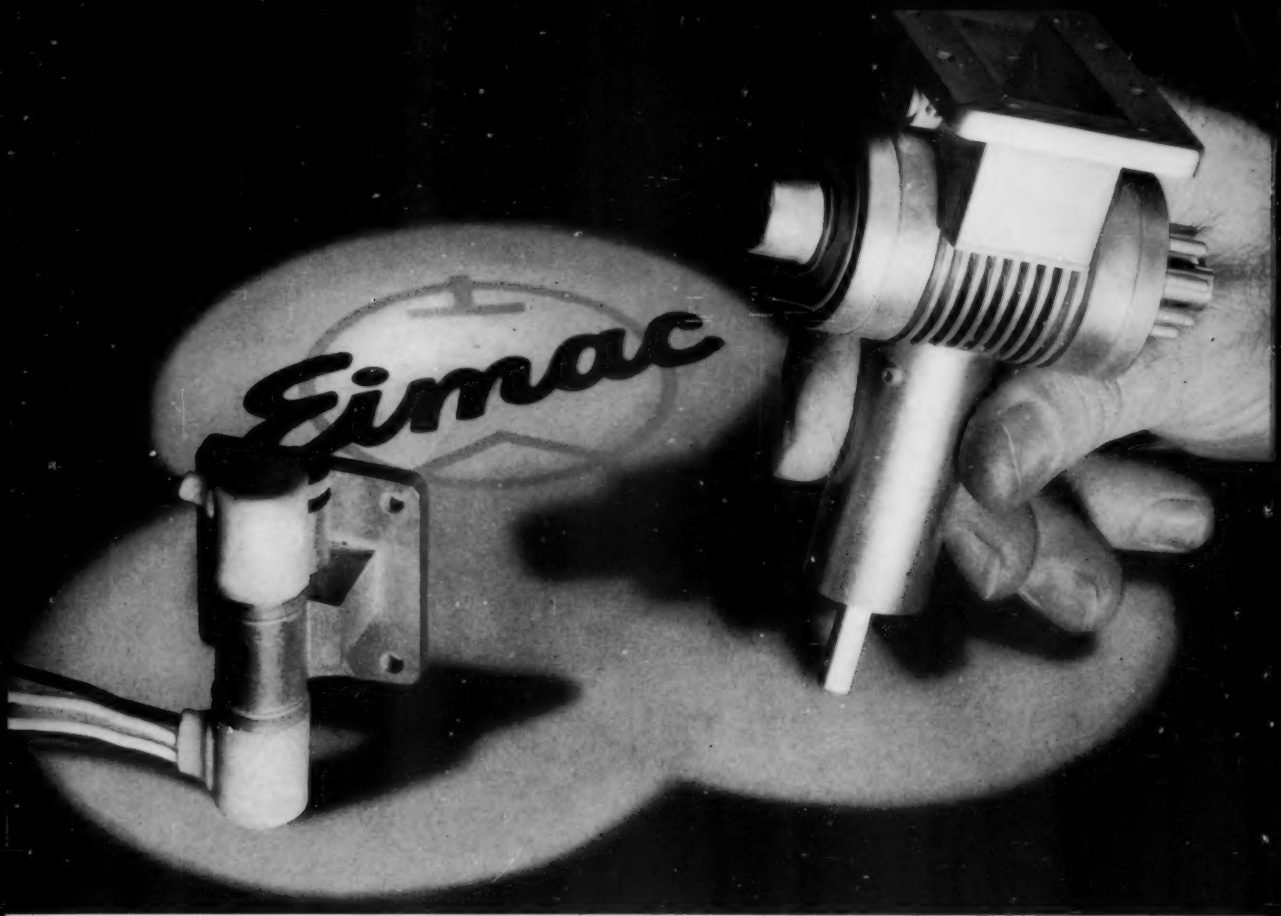

1K20 Series X and K Band Klystron (left)
1K125CA C Band Klystron (right)

Eimac Announces . . .

Five New Ceramic Reflex Klystrons

Two important frequency ranges in the C, X and K bands are now covered by Eimac ceramic reflex klystrons. Eimac's advanced stacked ceramic design gives these tubes exceptional ruggedness and frequency stability.

The four new tubes of the 1K20 series cover 8500 to 11,700 Mc. at power levels to 50 milliwatts. These tubes are specifically designed for use in the severe vibration and temperature environment of air-borne and missile radar systems. They will withstand vibration levels of 15G in any reference plane with less than 100 kilocycle frequency deviation. Rated for use at any altitude, the 1K20 series tubes are conservatively rated at +250°C seal temperature. A new non-contacting, non-microphonic tuner permits noise-free tuning of the tubes through their complete ranges. Low beam voltage requirement and simple radiation cooling minimize the weight and complexity of associated equipment.

Two new C-band tubes comprising the 1K125 series cover 3700 to 5000 Mc. Power levels up to 2 watts make these tubes ideal for reliable broadband point-to-point communication. Tuning by dielectric slug rather than variable RF gap avoids sensitivity to shock and vibration. Integral-finned cooler and higher operating temperature ratings minimize cooling requirements.

Eimac know-how in the field of ceramic-metal tube design now brings compactness, ruggedness, high performance and reliability to these important microwave frequencies.

5310-R

Eimac

Eimac First for high power amplifier klystrons.

EITEL-McCULLOUGH, INC.

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CANADIAN REPRESENTATIVE
R. D. B. SHEPPARD
2036 Prince Charles Road, Ottawa.

GENERAL CHARACTERISTICS

Type	Freq. Range Mc.	Beam Voltage	Power Output Range	Reflector Voltage
1K125CA	3700-4400	1000 Vdc	1.5 to 2.0 W	0 to —1000 Vdc
IK20XS	8500-9300	300 Vdc	25 to 50 mW	0 to —250 Vdc
1K20XK	9200-10,000	300 Vdc	25 to 50 mW	0 to —250 Vdc
1K20XD	10,000-10,800	300 Vdc	25 to 50 mW	0 to —250 Vdc
1K20KA	10,700-11,700	300 Vdc	25 to 50 mW	0 to —250 Vdc

Additional Frequency Coverage to be announced soon